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JANUARY 1947

SCIENCE NEWS

Atomic Race Track 75
Birth of a Mesotron 75
Microwave "Gun" 76
Man-Made Snow 78
You'll Hear from FM in '47 128

SCIENCE AT WORK

It Sizes Up Clouds 77
Tank Tester 79
Building Rolls with the Punch 80
Servants from the Laboratories 93
Wiring Diplomats for Sound 116
Wrap It Up! 121

PSM FEATURES

Picture of the Month 65
Here Come the New Fire Engines 66
Lighter "Icer" Hits the Rails 74
Airport Snow Remover 79
Aluminum Span 90
Tractor for Latins 91
Smothers Fire 92
Behind the Signs 99
Battlewagons for Today's Fire Fighters 104
Diamonds Dig for Gold 106
Britain Streamlines the Goods 110
For Fun-Loving Executives 115
How Water and Gas Meters Work 134
Four Walls from Palm Trees 168
Table Magic 186
Emulsions Prove Oil and Water Mix 200

AVIATION

1,700 m.p.h.? 81
Gas Station in the Sky 82
Fastest Primary Trainer 83
Clocking a Black Streak 84
How Do They Know What Happened? 85
Inside the Flying Wing 95
Northrop Flying Wing (Pin-up) 97
New Jobs for "George" 111
Newest Aeronca 120
Torture Rack 133

AUTOMOBILES

Blowouts on Purpose 73
Car Snowshoe 91
Jenkins Tunes New Speed Machine 108
France's Postwar Cars 120
Get the Most from Synthetic Tubes 140
Gus Drops In for Pie 144

INVENTIONS

Tractor Loader 73
I'd Like to See Them Make 98
New Ideas from the Inventors 118

PHOTOGRAPHY

Animal Portraits with Flash 178
Spinning Can Tests Synchronizer 182

(CONTINUED ON PAGE 4)

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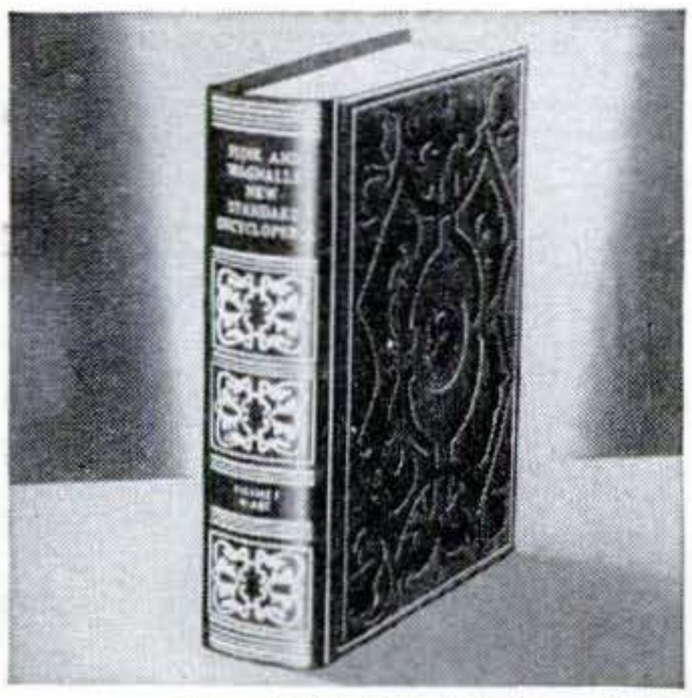

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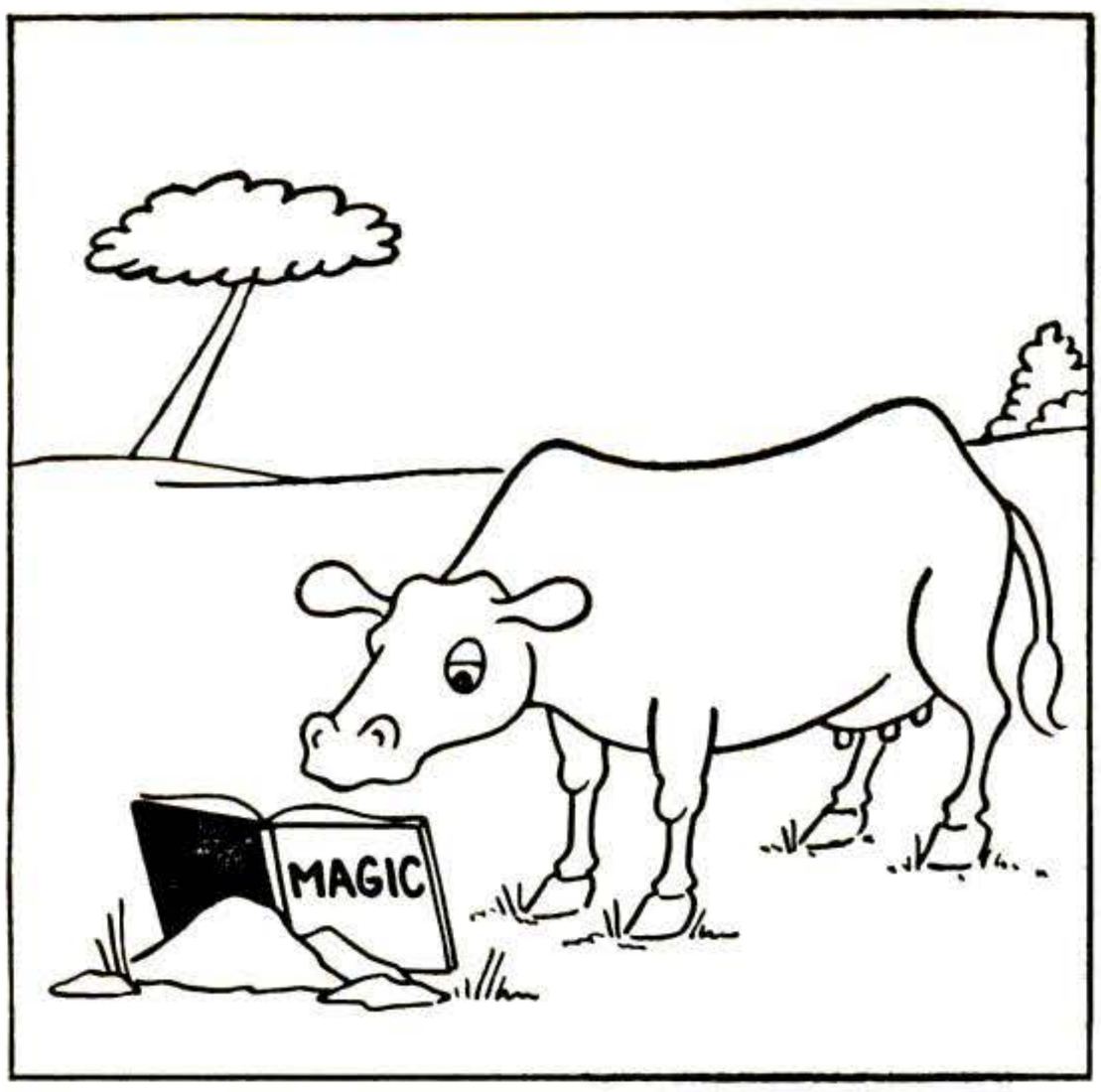

MECHANICS & SHOPCRAFT

Civil War Cannon Modeled in Brass.....152
Block Tool Holder.....170
Flexible-Shaft Tool.....172

HOME MECHANICS & HANDICRAFT

Coffee Table in the Modern Trend.....148
Candle Holder from Bottle and Can.....149
Bride-and-Groom Book Ends.....150
Jig Squares Picture Frames.....150
Stand Holds Portable Phonograph.....151
Auto Valve Makes Bench Hardy.....154
Keeping Hubs Aligned with Wheels.....154
Molding Silver Jewelry.....157
Bookcase of Scrap Paneling.....160
Making Your Own Window Sash.....162
Can You Tell by Eye?.....169
Record Album Holds Saw Blades.....171
Bookstand Has Storage Space.....171
Repairing Women's Handbags.....184
How to Carpet Your Stairs.....187
Woodworking Quiz.....195
Pin Vise with Squared Handle.....195
Tin Strip Keeps Key in Lock.....198
Parlor Football Game.....199
Hog Feeders Lessen Farm Chores.....205
Double Snow Shovel Saves Time.....206
Fluorescents Grow Cellar Plants.....207

RADIO & ELECTRICITY

Electrified Sun Room..... 73
Static Eater..... 76
Electronic Stop Watch..... 77
Veteran at New Job..... 90
Ham Pioneers..... 92
Directory Dials the Phone.....126
New Electrical Appliances.....127
Circuit Tester Uses Tuning Eye.....189
High Fidelity with Two Tubes.....190
News in Electronics.....194
Switches from Plastic Bottle Caps.....204

DEPARTMENTS

Voice of Science..... 7
Letters 16
Modern Living.....136
Auto Ideas.....138
What's Your Ingenuity Quotient?.....155
Craftsmen at Work.....156
New Tools.....161
Keeping the Home Shipshape.....166
New Shop Ideas.....176
Photo Ideas.....183
Home Experiments.....196
For Easier Farming.....208
Editorial Memo.....278

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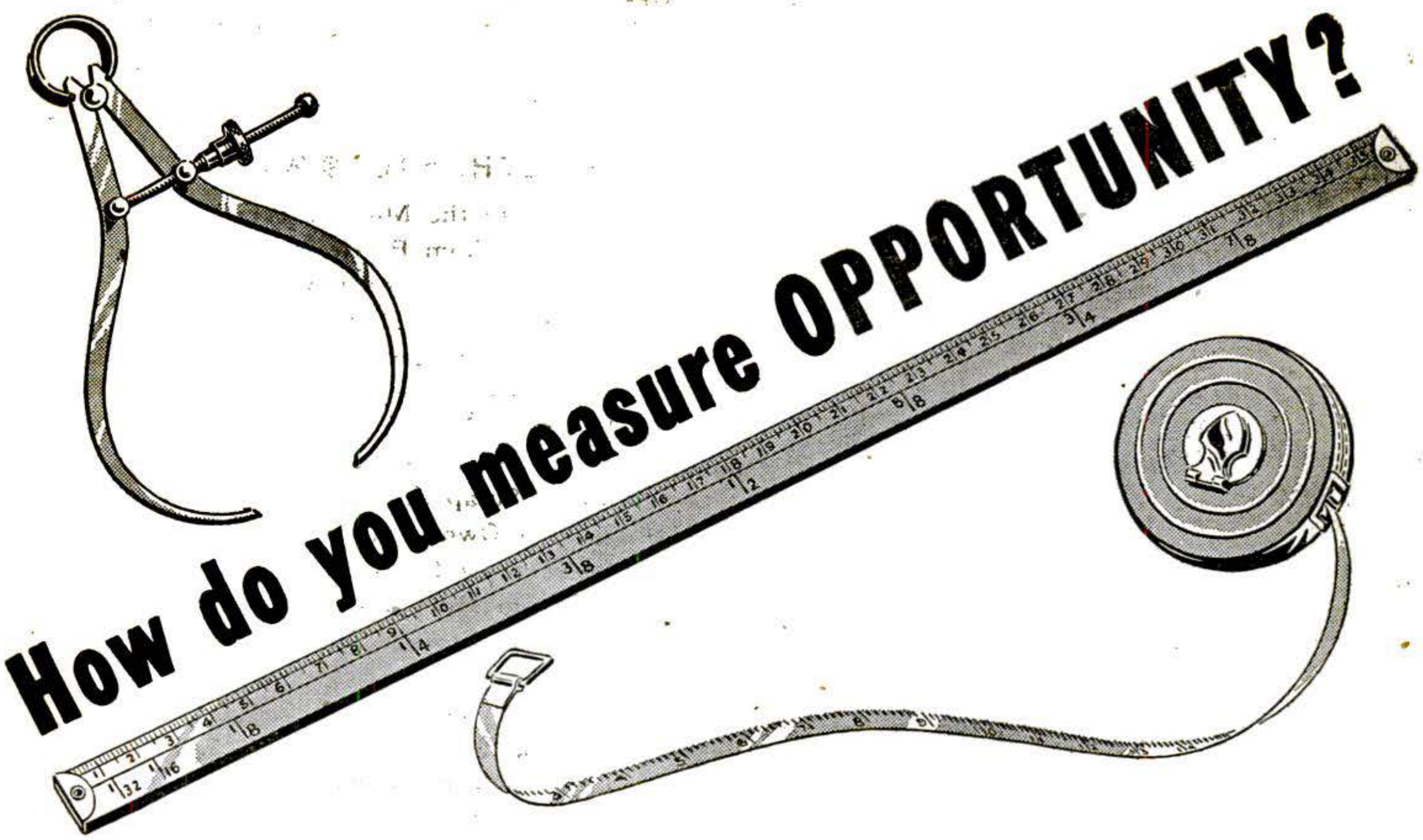

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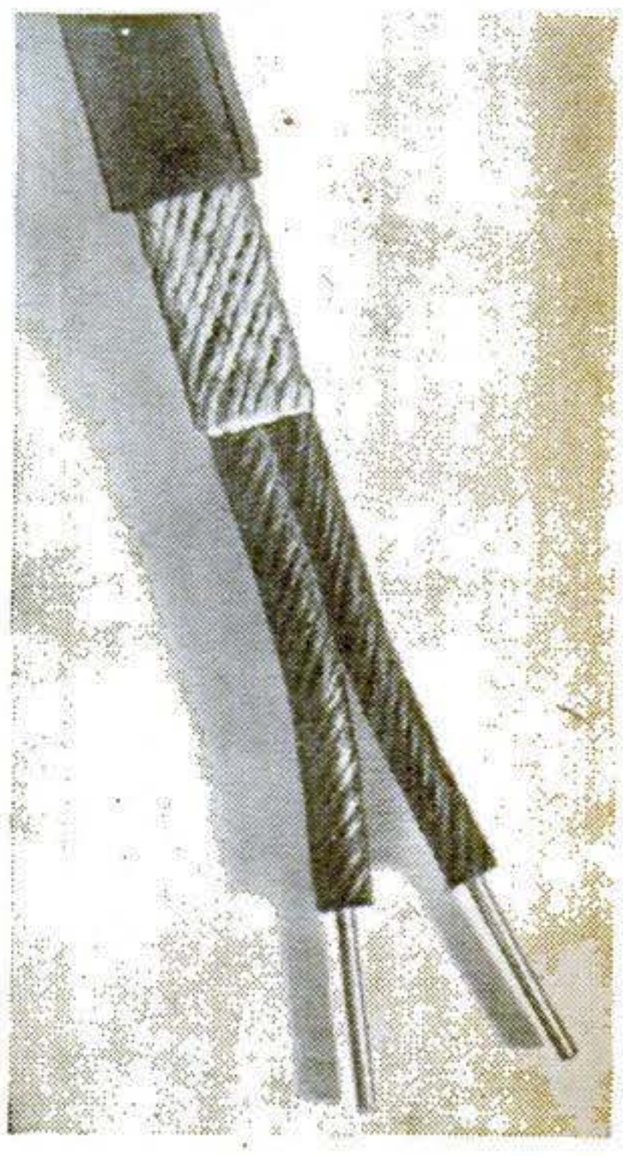

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VOICE OF SCIENCE

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Scientifically, facsimile has long been finished business; even its engineering is old stuff. But it will probably be quite a while before you pick up your morning paper from the rug rather than the doorstep. There's a little difficulty figuring who's going to pay whom how much. Not to mention writing off the costs of presses, engraving plants, linotypes, and trucks.

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Take radar, the wonder boy of the war, now stymied in its immediately possible application to air-line operations for several reasons—none of them having much to do with radar's scientific development. Or take air conditioning, or the various sound-recording systems, or a dozen other things all fully developed scientifically, ready to go to work for you *now*—but stopped short for reasons beyond the scientist's control.

Or, if you want to get really indignant at man's capacity for getting in his own way, take that biggest thing in scientific history—nuclear fission—which, because of the limitations of the diplomats, militarists, and economists, has still failed to pay a visible dividend to mankind.

Perry Gilkeys

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WERE the great personages of the past victims of a stupendous hoax? Could such eminent men of the ancient world as Socrates, Pericles, and Alexander the Great have been deluded and cast under the spell of witchcraft—or did the oracles whom they consulted actually possess *a mysterious faculty of foresight?* That *the human mind can truly exert an influence over things and conditions* was not a credulous belief of the ancients, but a known and demonstrable fact to them. That there exists a wealth of infinite knowledge just beyond the border of our daily thoughts, which can be aroused and commanded at will, was not a fantasy of these sages of antiquity, but a dependable aid to which they turned in time of need.

It is time you realized that the rites, rituals and practices of the ancients were not superstitions, but subterfuges to conceal the marvelous workings of natural law from those who would have misused them. Telepathy, projection of thought, the materializing of ideas into helpful realities, are no longer thought by intelligent persons to be impossible practices, but instead, *demonstrable sciences,* by which a greater life of happiness may be had.

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I am sincerely interested in knowing more about this unseen, vital power which can be used in acquiring the fullness and happiness of life. Please send me, without cost, the book, "THE MASTERY OF LIFE," which tells me how to receive this information.

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If YOU *were Boss would* YOU *promote* "YOU"?

Be honest now—

suppose that a better job had opened up in your company—carrying with it promotion and more money—could you qualify?

If you were boss, would you select "YOU" for that better job?

Consider before you answer.

First of all, could you *fill* the job? Has your experience fitted you for the step forward—have you been preparing for promotion apart from experience gained on the job?

Or have you just been filling a niche, doing daily tasks well but making no real and intelligent effort to learn and qualify for the job ahead so that if an opening should occur you would be ready to fill it?

The man who gets real promotion makes his own breaks—the man who slaves in the ordinary job at low pay just wishes and dreams of promotion and more money. Which are you?

Business is always willing to pay the man who knows—and pay him well. The man who is ready and willing to take responsibilities—and capable of directing the efforts of other men is a valuable asset to any business organization. He never wants for a good job and above average earnings. He gets ahead.

We have helped thousands of men achieve promotion and more money—success sometimes beyond their dreams—a success that was started by a coupon similar to the one below.

Get out of that rut—don't be satisfied with a mediocre job at small pay—be a success in business—this coupon may be your first step.

So send it today—right now—tomorrow never comes for the man who consistently puts things off.

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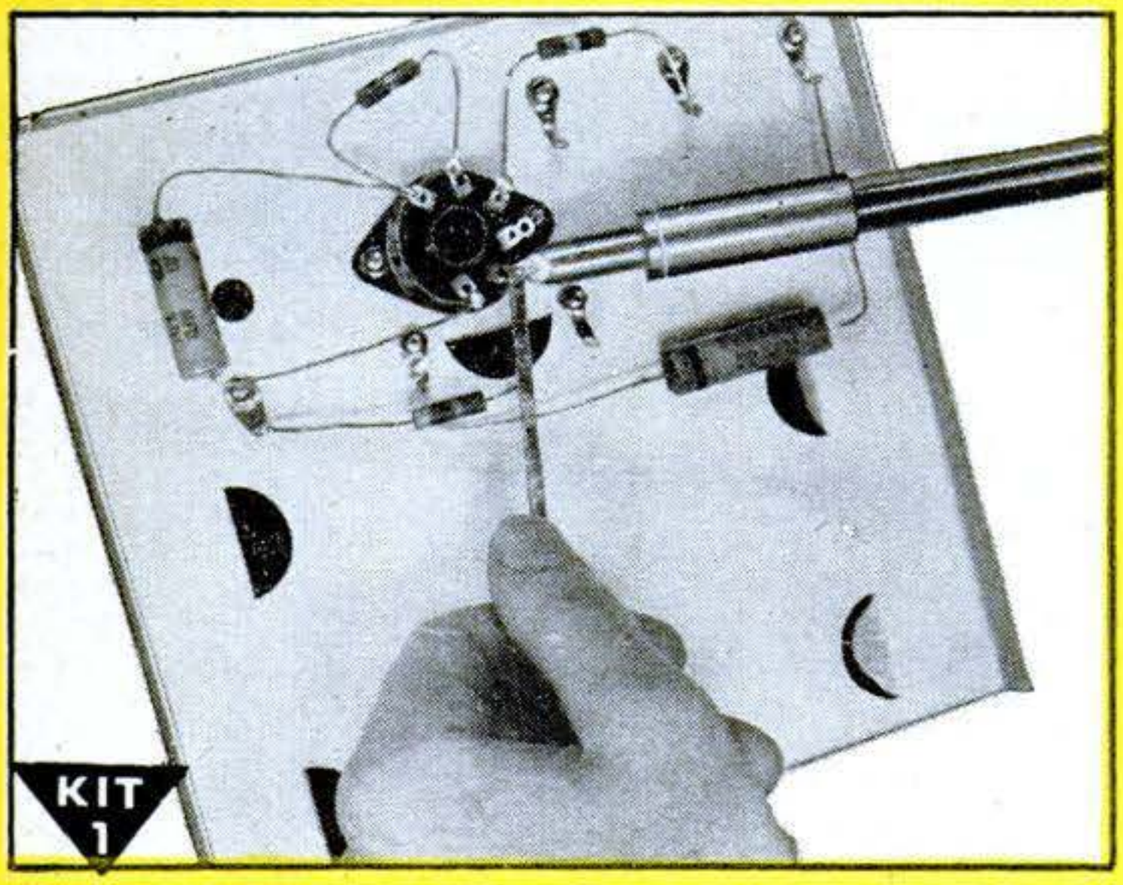

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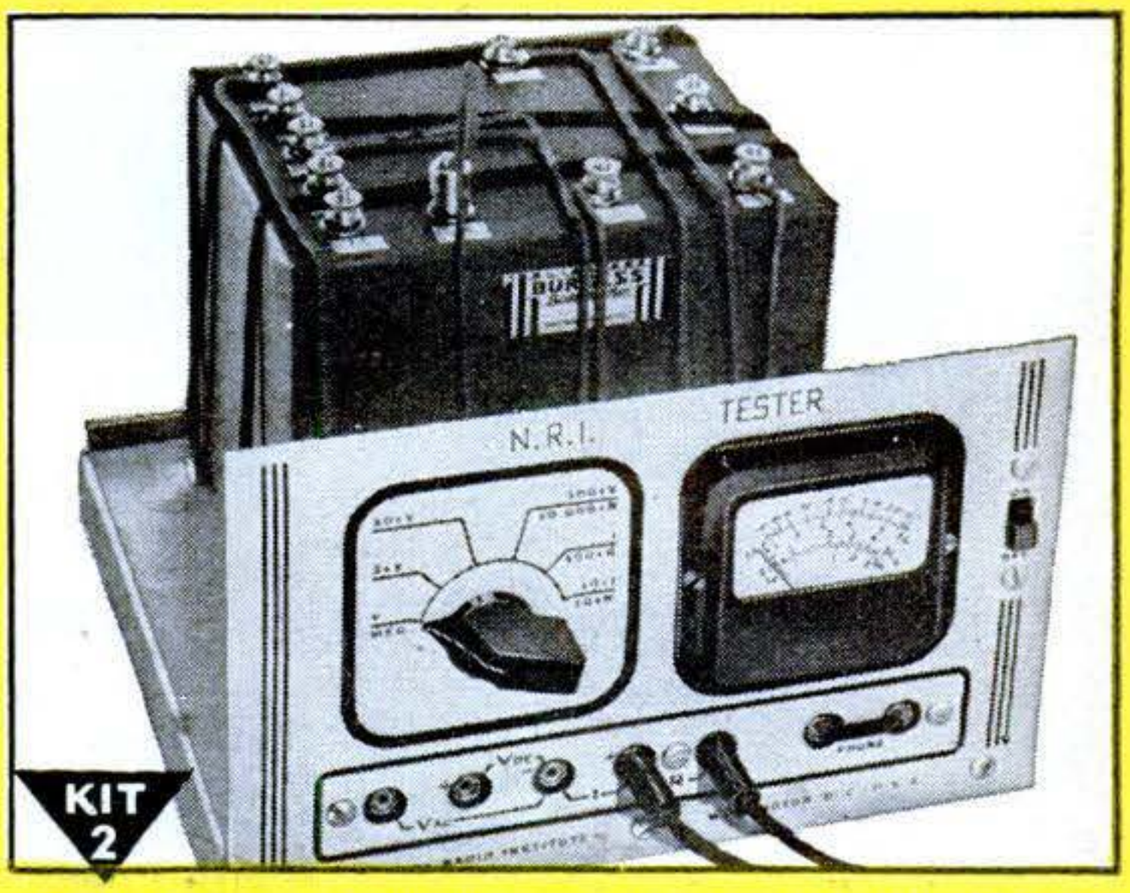
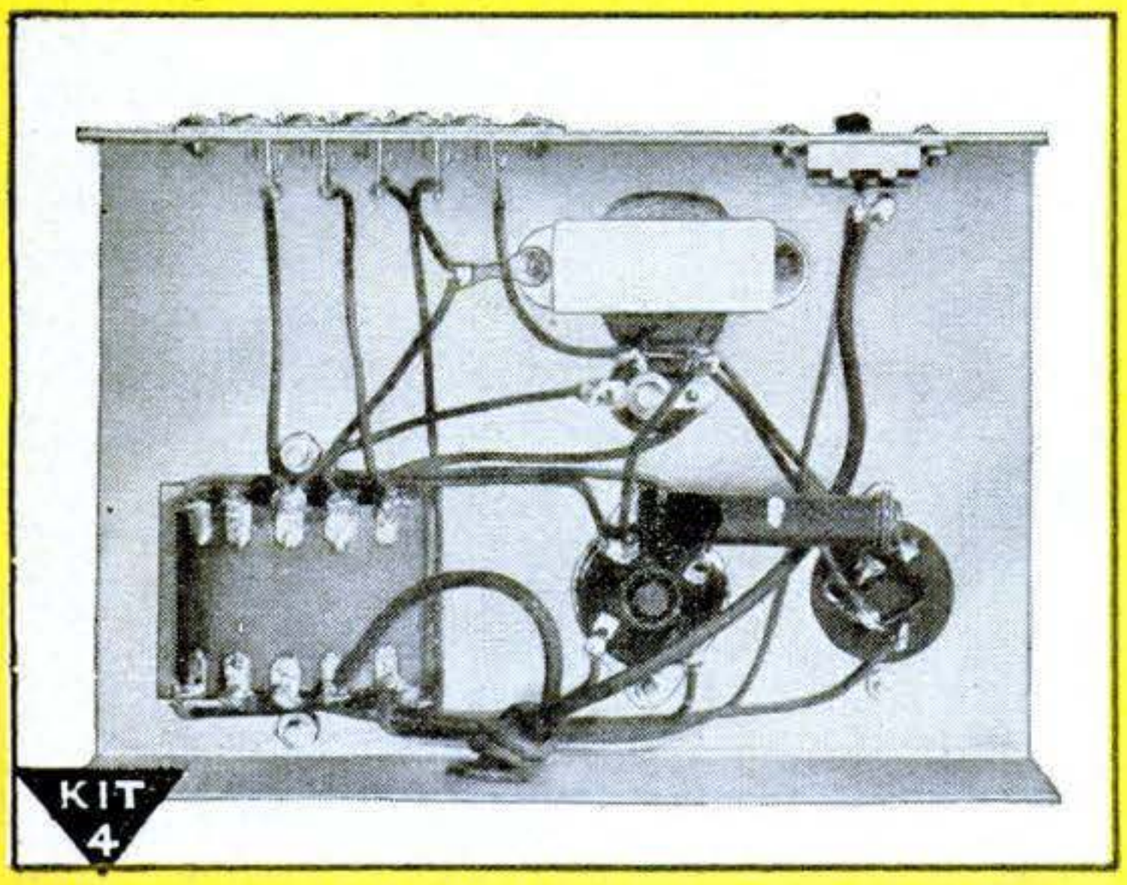
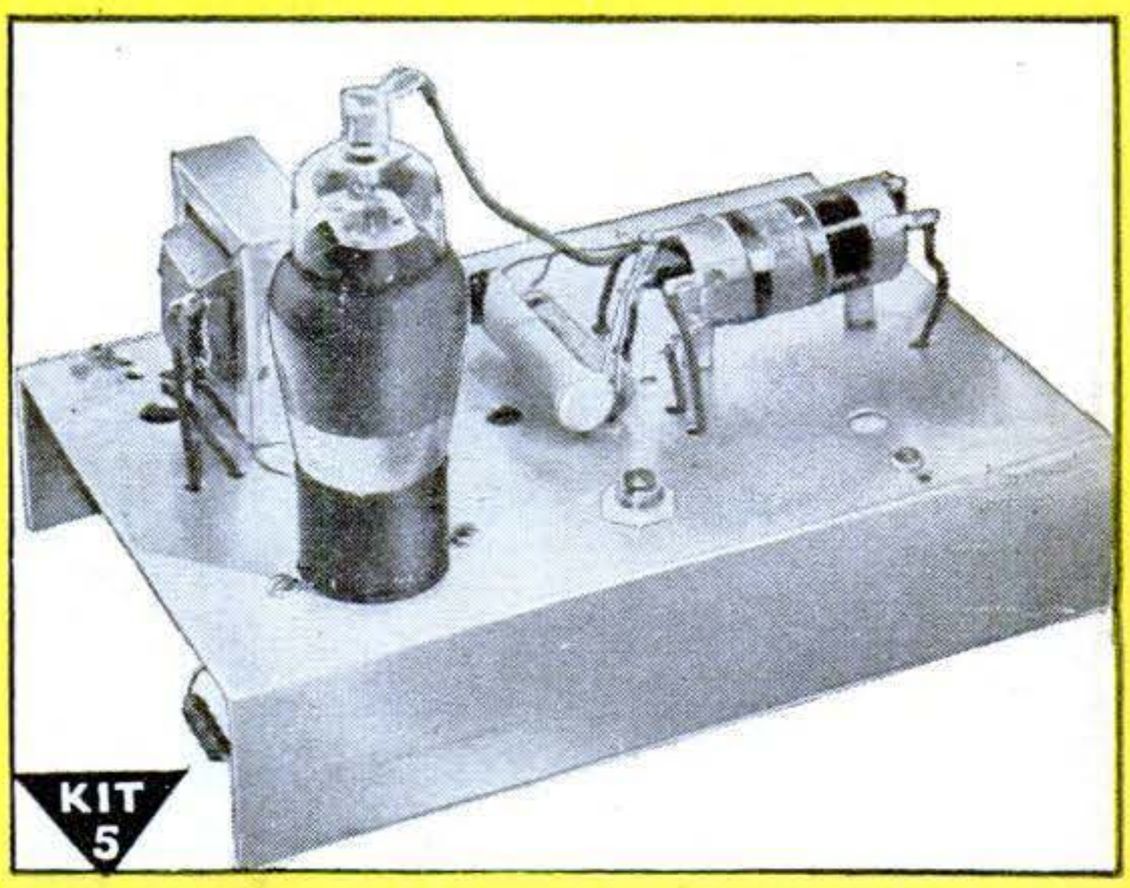


Early in my course I show you how to build this N.R.I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.



You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.

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Chief Engineer Station KWLM

"Am now Chief Engineer of Station KWLM and in charge of maintenance of Police Station KRIN. County Highway Dept. Also have my own business. Mighty glad to be in radio."—LLOYD V. STENBERG, 516 Litchfield Ave., W., Willmar, Minn.

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"I am still climbing as a result of my N.R.I. training. I now do aircraft radio work at Greenwood Army Air Field, and operate a radio shop in my spare time."—JAMES L. BOYETT, P.O. Box 218, Greenwood, Miss.

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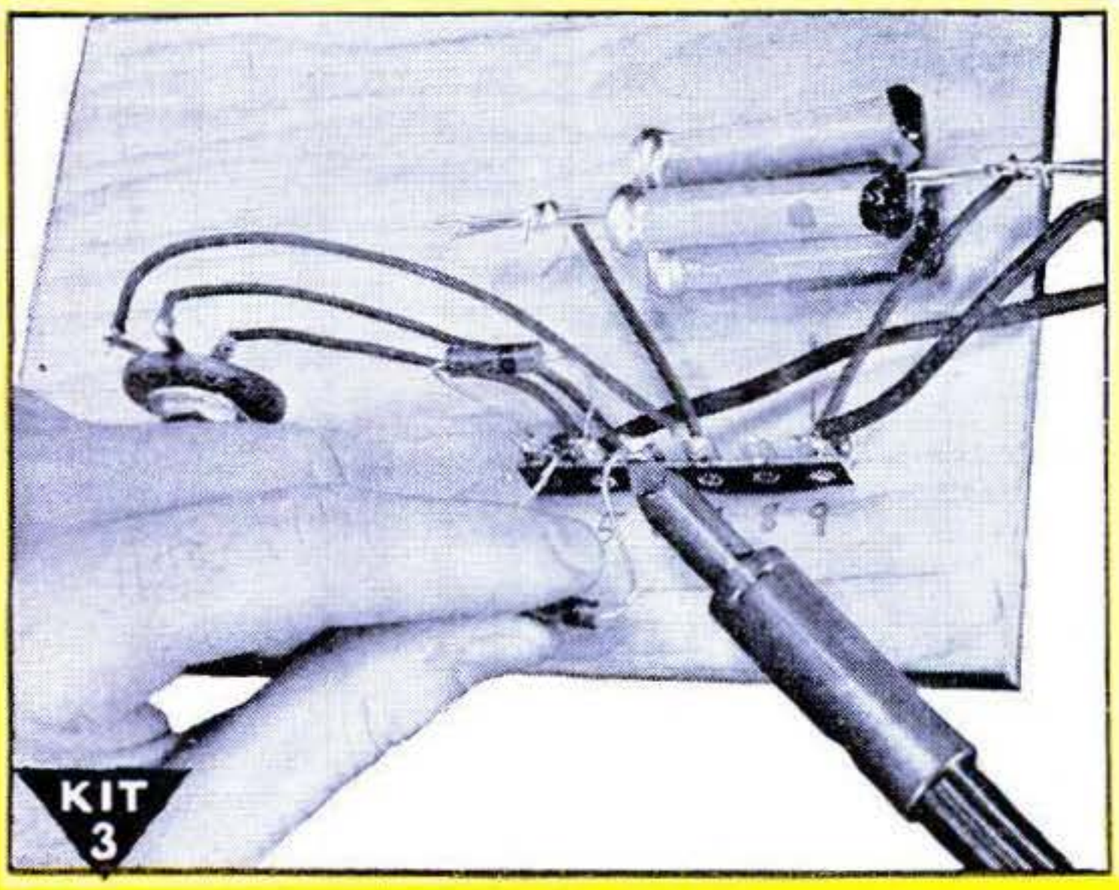
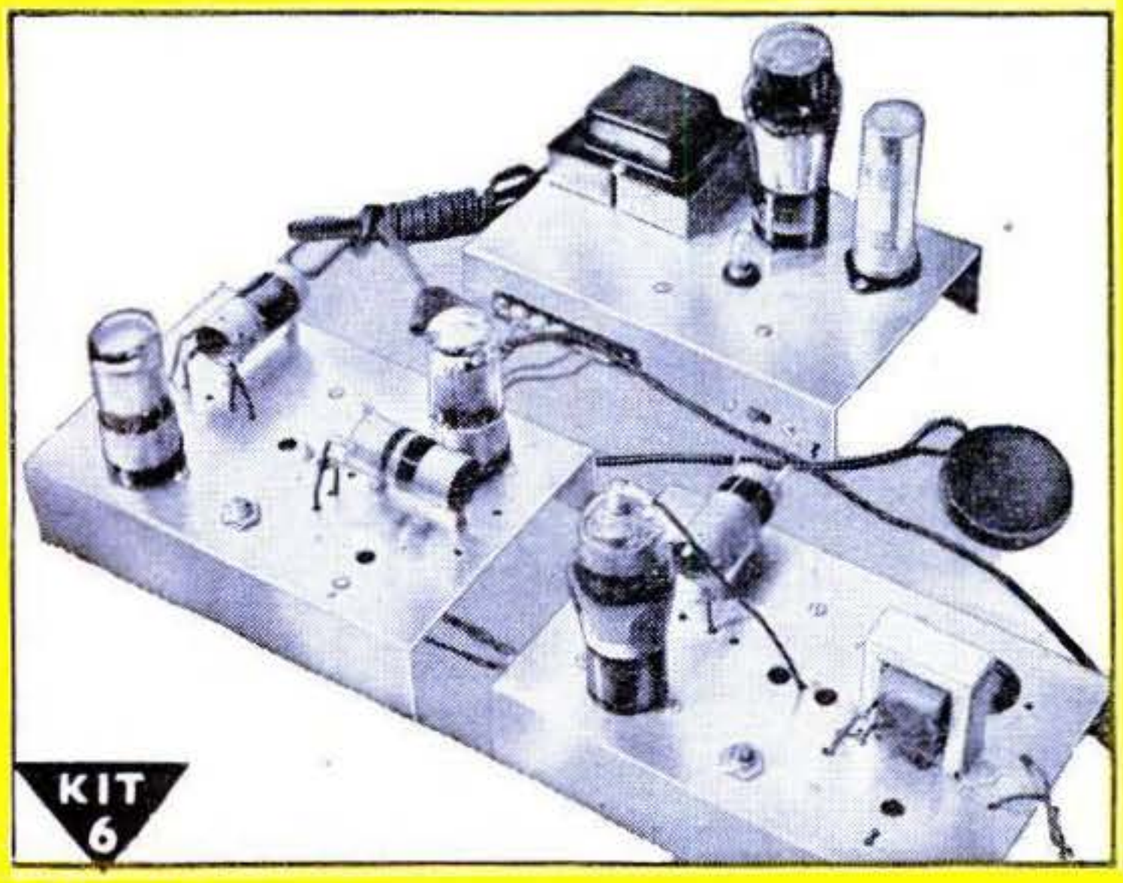


You get parts to build Radio Circuits; then test them; see how they work; learn how to design special circuits; how to locate and repair circuit defects.



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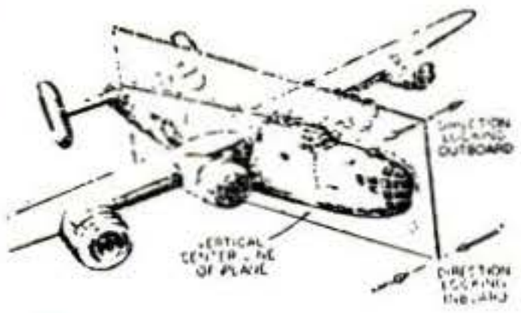

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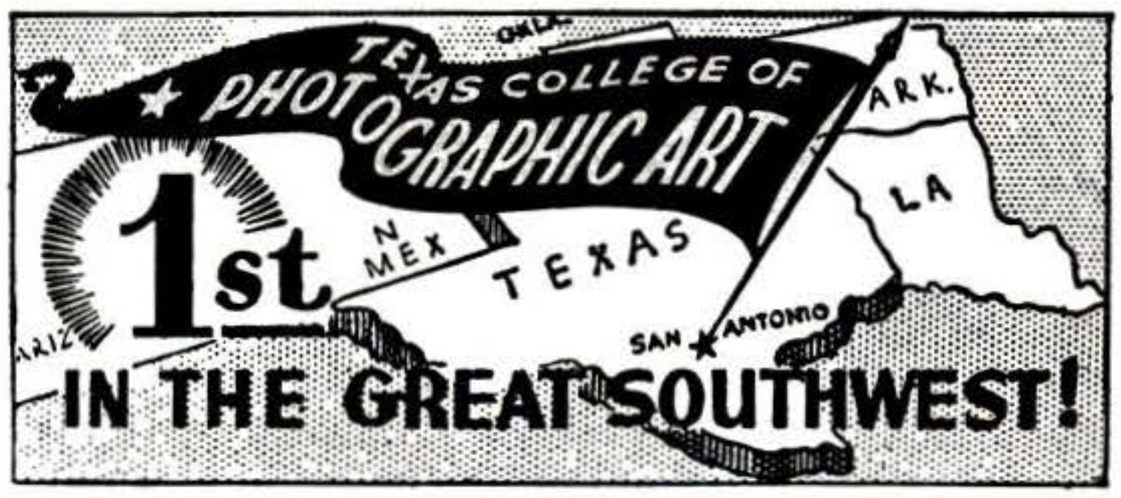

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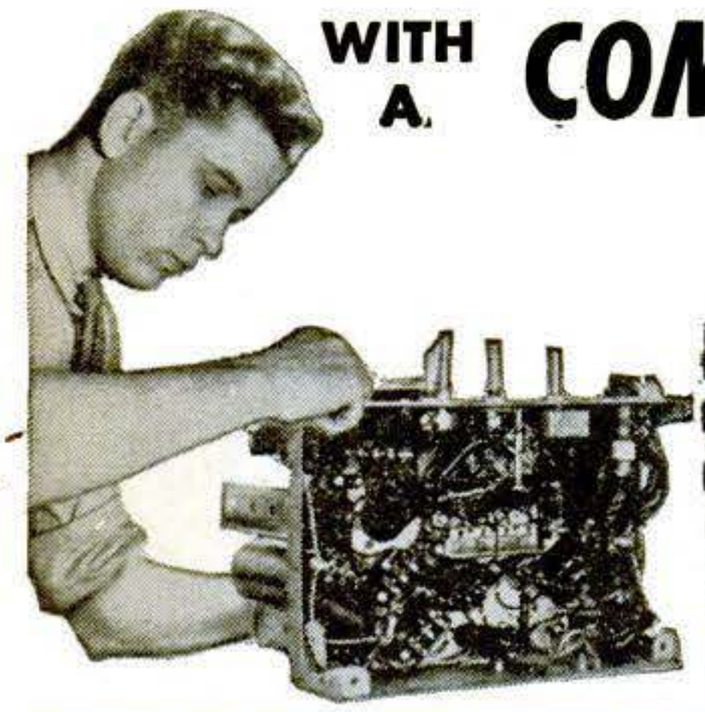

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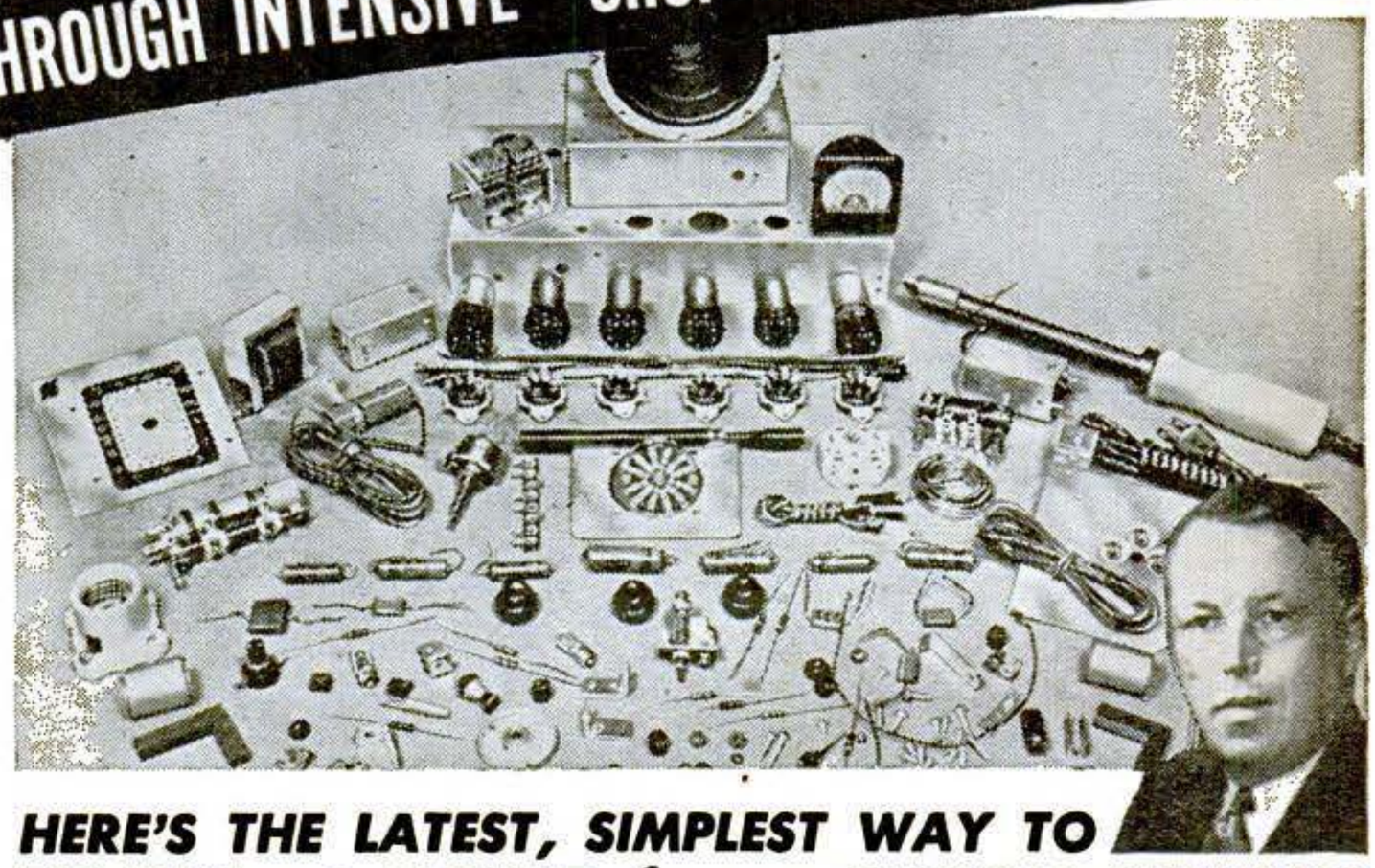

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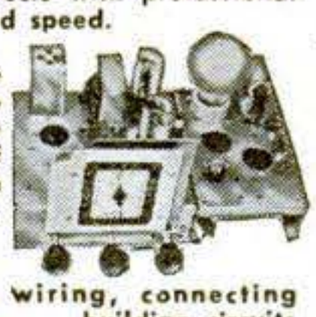

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Soldering, wiring, connecting Radio parts . . . building circuits with your own hands—you can't beat this method of learning. When you construct this Rectifier and Filter, Resistor and Condenser Tester, etc., you get a really practical slant on Radio that leads to a money-making future.

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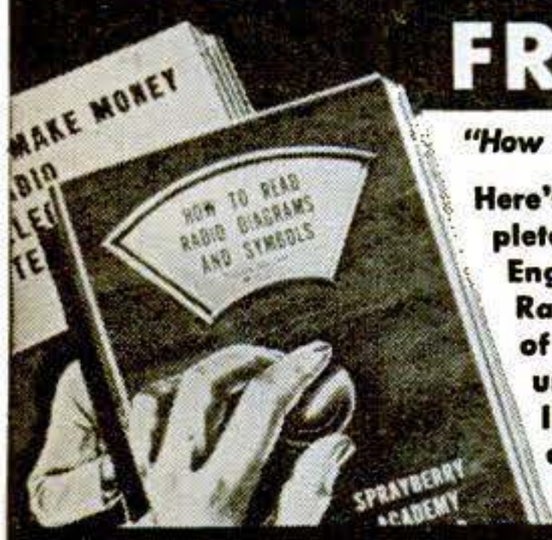

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MRS. M. D. BLANKENHORN
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PSM is happy to provide such material.

A First Installment

Sir:

Let's have some latest news about the cosmic rays in your future issues, and their effects.

FERNANDO VENTRESCO
Madison, Maine

See page 75 for one effect of cosmic radiation—the creation of a mesotron. There'll be more news when the scientists produce it.

One Good Turn . . .

Sir:

These lines to let you know who I am and what I want. During the occupation, I had the chance to rescue three Army Air Forces boys . . . and conduct them safely to freedom. Since the liberation, I have had copies of Popular Science which were very precious to me. Is there a possibility for me to obtain the years 1944 and 1945? (Reference: Major White, Intelligence Service, Paris.)

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Laval (Mayenne), France

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American aviators shot down in France . . . He clothed, sheltered and fed three Americans for a month and shuffled them around until we could evacuate them. This was not the least of his work for us, so that we will indeed be grateful for any service you may render him.

JOHN F. WHITE
Major, Air Corps

Paris, France

Monsieur Georget has received the copies he missed because of the German occupation; he also has PSM's sincere thanks for his aid to U. S. airmen.

For Sulphur, Read Sodium

Sir:

Howard Blakeslee, in his article, "Building Blocks of Science," in your November issue, refers to element No. 11 as sulphur; actually, it should be sodium, as it appears in the table.

M. JOHN MARKUSON, JR.

Amherst, Mass.

Right. There was also an error, we regret, in the art that illustrated Mr. Blakeslee's article: the symbol for thallium was incorrectly given as Ti instead of Tl. But this misprint will be corrected in color on page 112 of PSM's February 1947 issue, so that those who made the "chemical castle" can paste on the proper block.

Those Thermostats

Sir:

It was very interesting to note in the November "Letters" section mention of my article on "How to Service-Check Your Oil Burner" by Mr. C. E. Smith. His points on cleaning thermostats are no doubt correct

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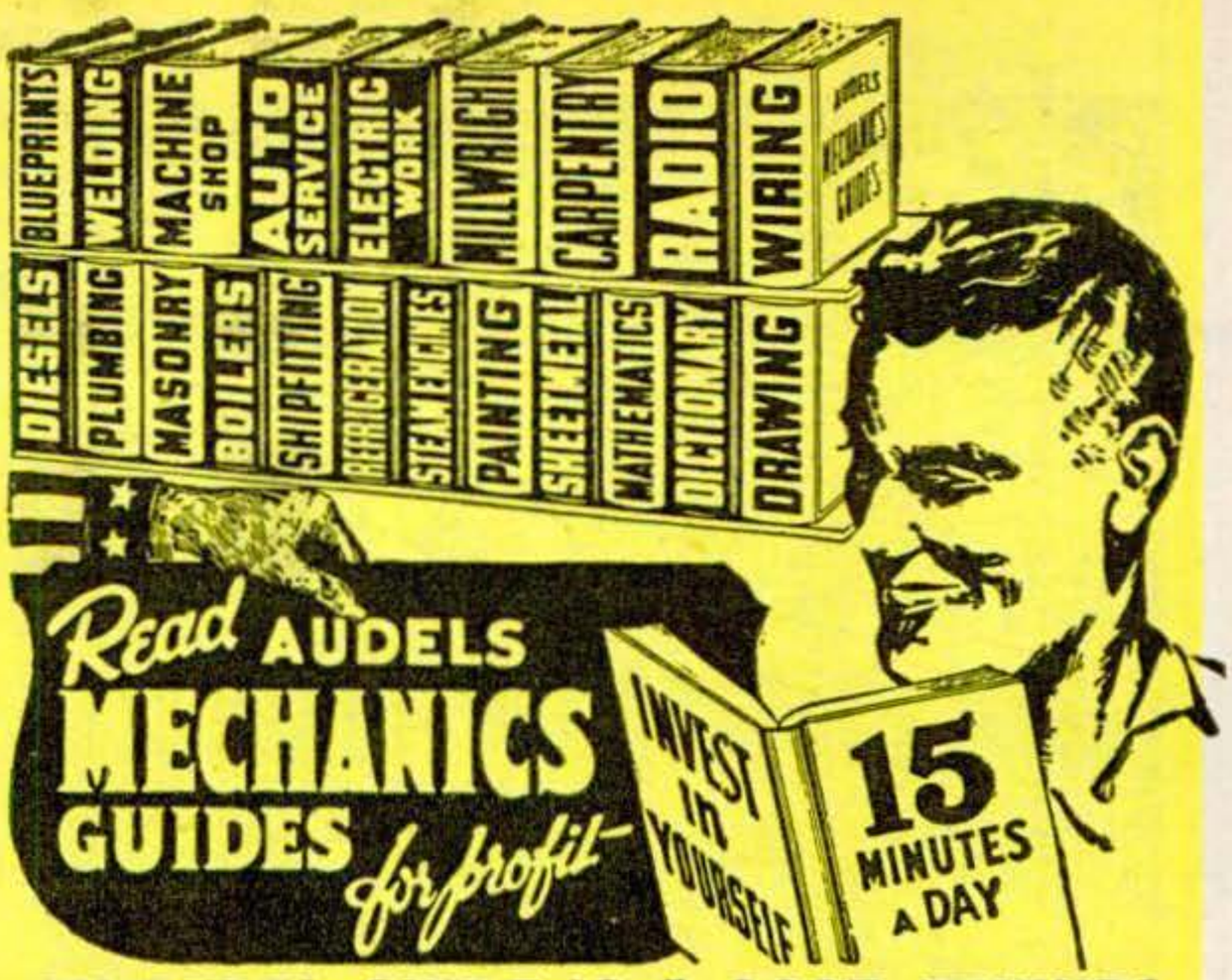

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practice. . . . I also suggested this treatment. However, in some cases, especially line-voltage thermostats which directly operate motors, contacts become pitted and so dirty that the paper treatment will do no good. In such cases, the use of a very thin, fine-cut file or fine sandpaper must be resorted to, of course using but slight pressure. In fact, when pitting has taken place, the thin alloy mentioned by Mr. Smith must be already penetrated, so cleaning up such contacts in any way possible is about all anyone can do, outside of replacing the contacts.

HAROLD P. STRAND

Malden, Mass.

Catching Up with Watches

Sir:

In a recent issue, Howard Calder would "like to see them make" a device to stop the winding of a watch when it was complete. That feature is incorporated in the Howard watch that I have owned for 50 years.

JOSEPH H. NETTLETON

New Milford, Conn.

Sir:

. . . I have a 20-year-old Swiss watch which can be wound indefinitely because the ratchet slips out of mesh when fully wound.

ALLEN BETTS

Bethesda, Md.

Enlightened, PSM agrees that the idea is not new, but feels that it could well be put to more general use.

Off the Beam

Shannon

Hays

PSM's apologies to Lt. Col. Frank J. Shannon and Maj. Norman P. Hays, communications officer and navigator, respectively, of the Pacusan Dreamboat. In the story of their exploit in the December issue, their pictures were transposed. If the art department and composing room could read their call signs as well as Col. Shannon, or take fixes as well as Maj. Hays, things like this wouldn't happen.

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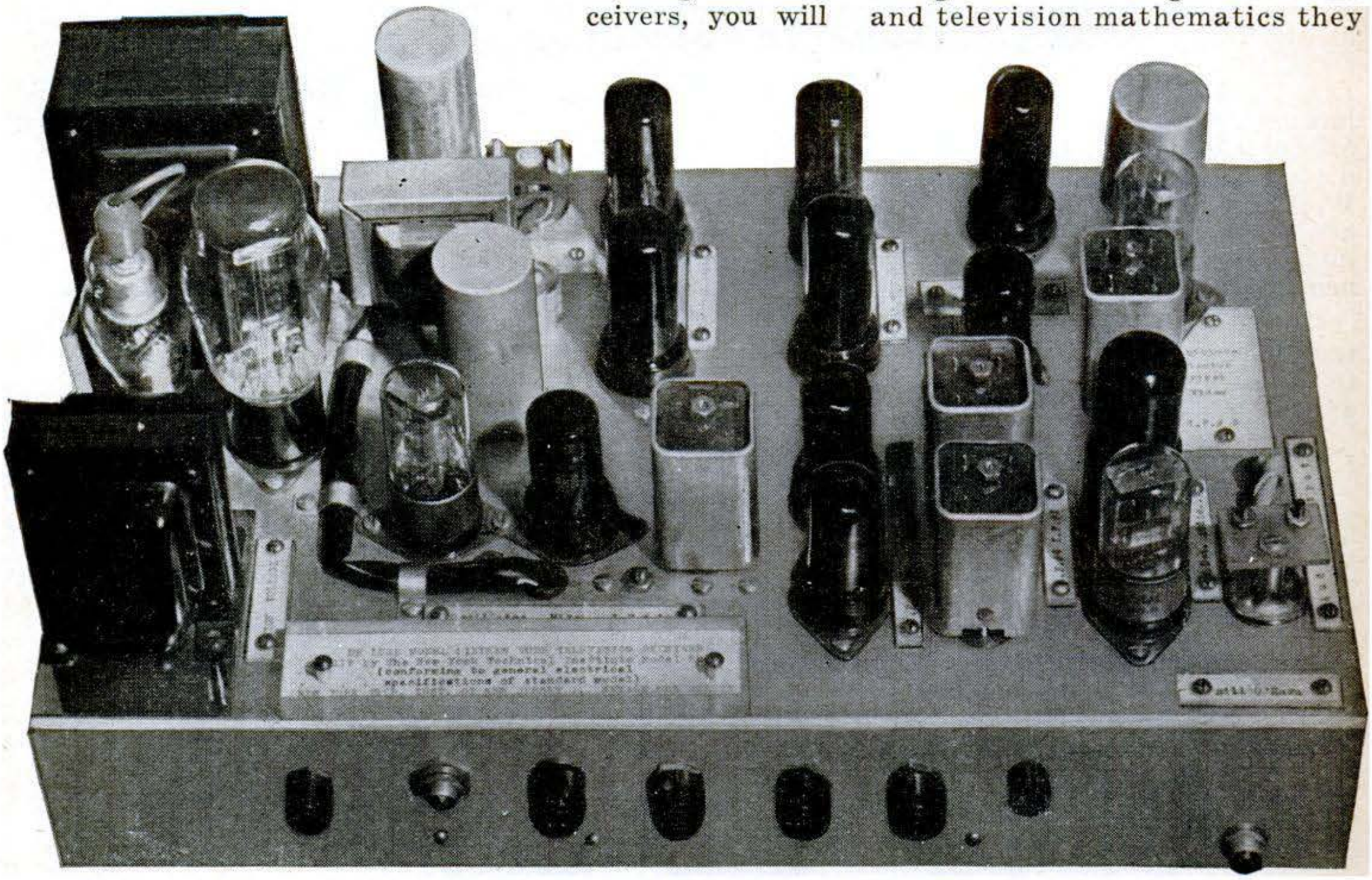

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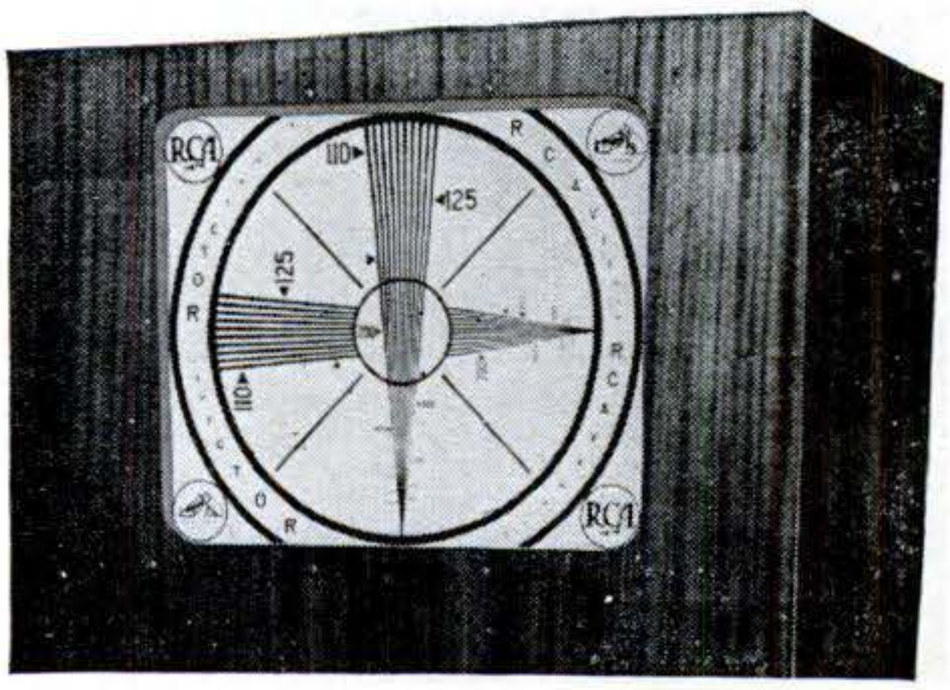

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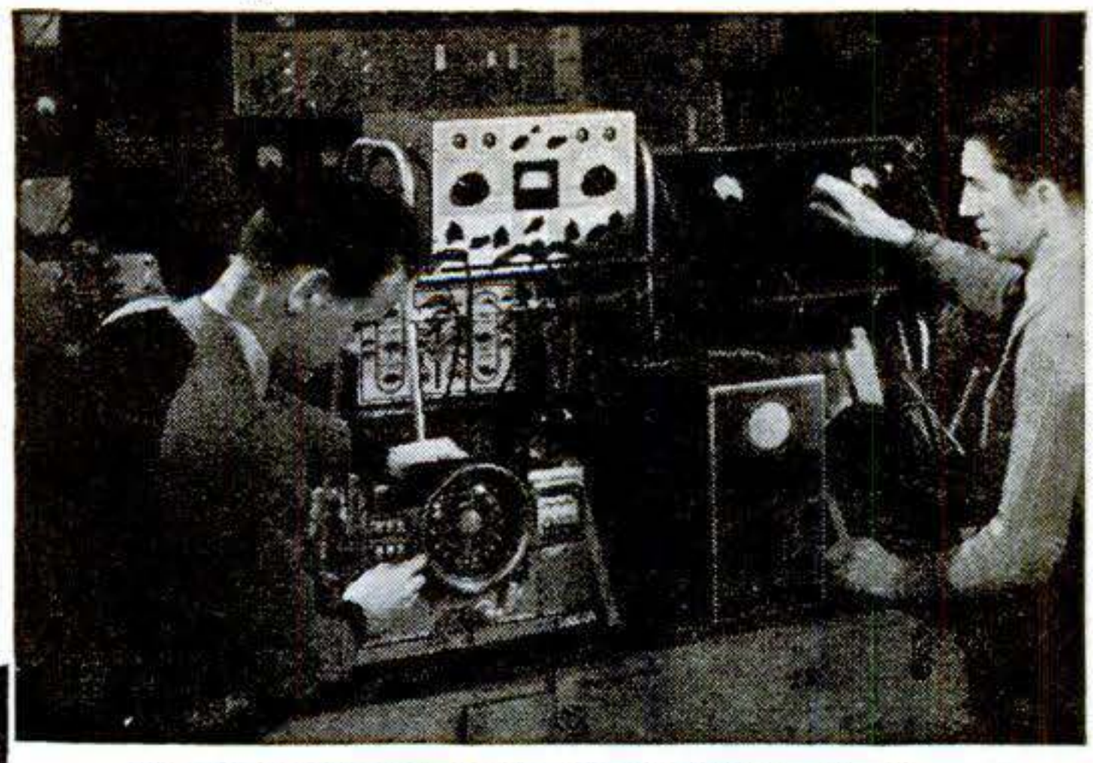

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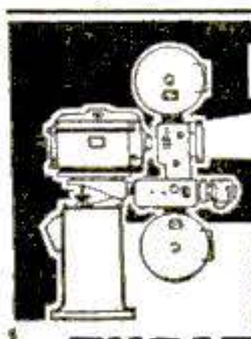

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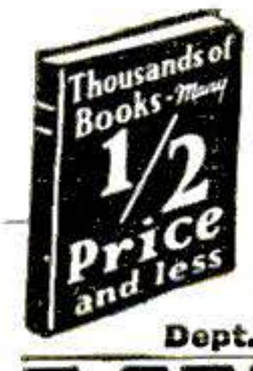

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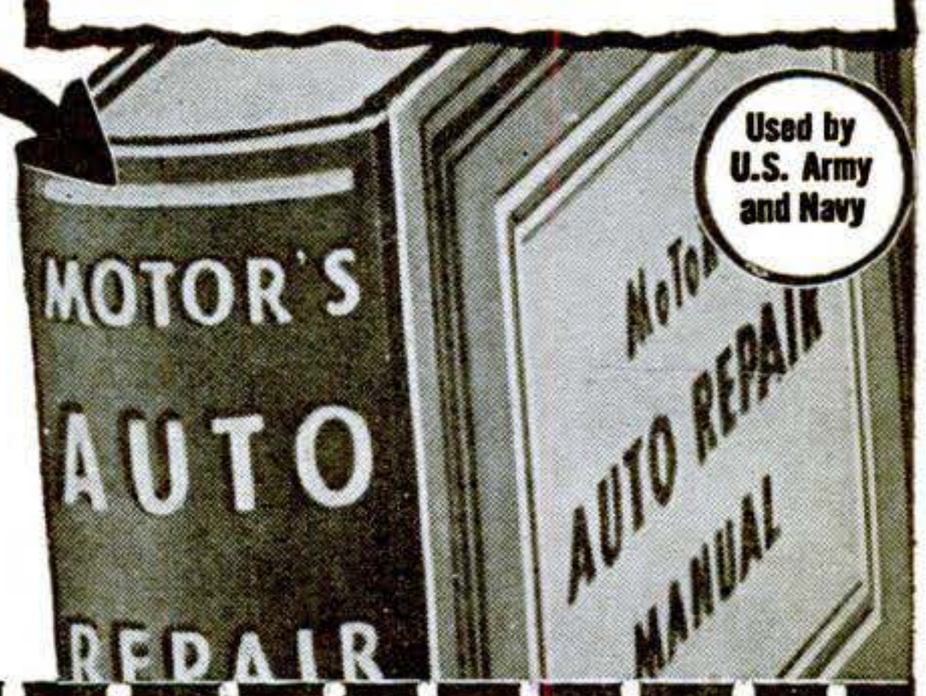

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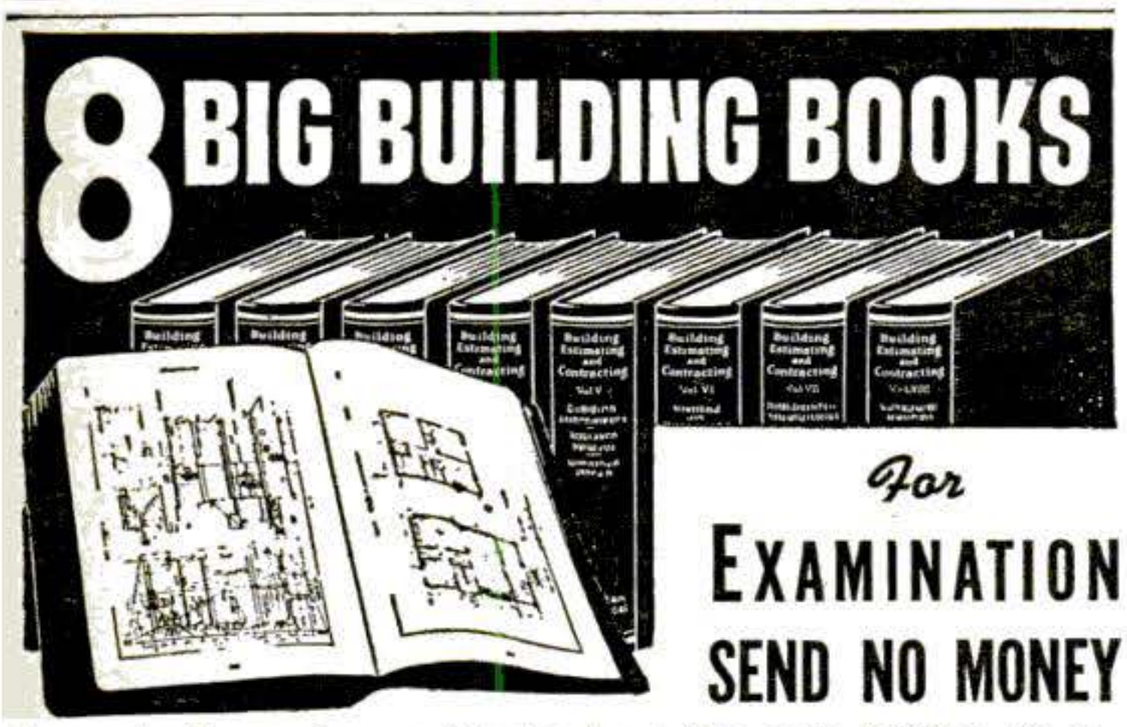

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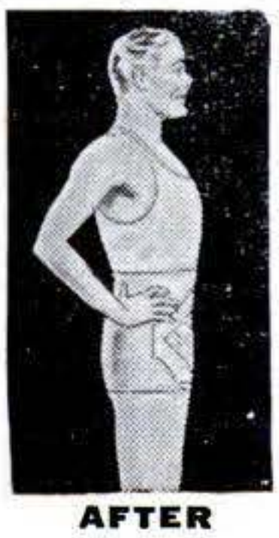

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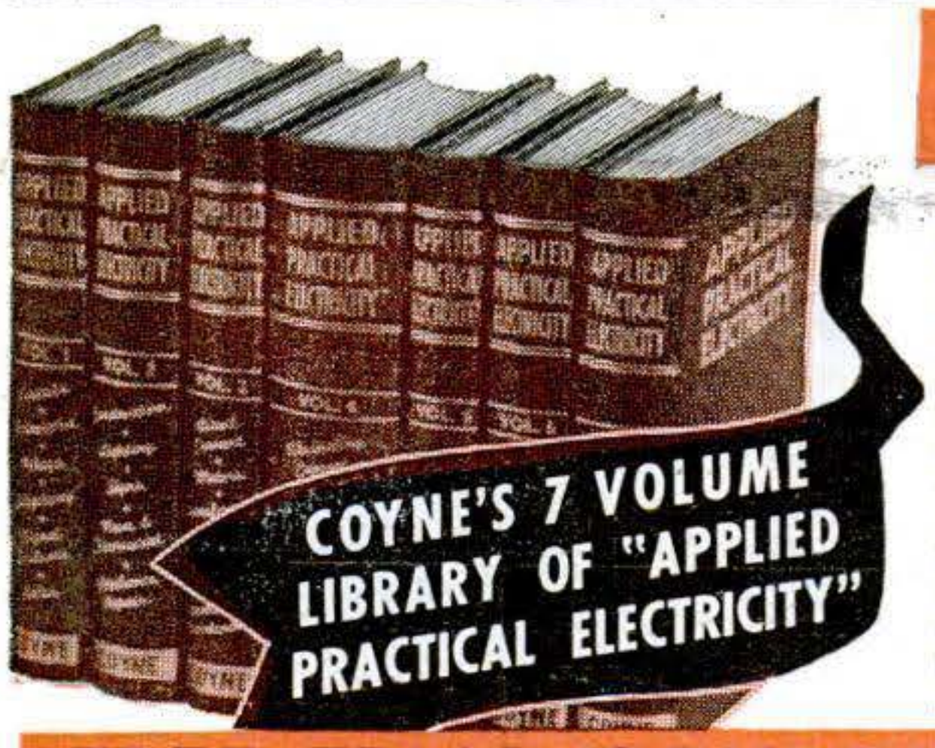

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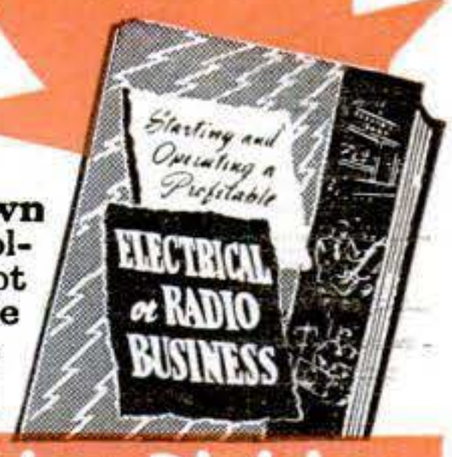

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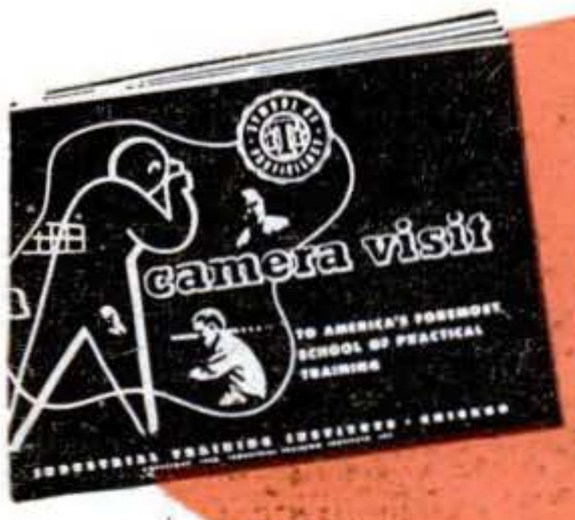

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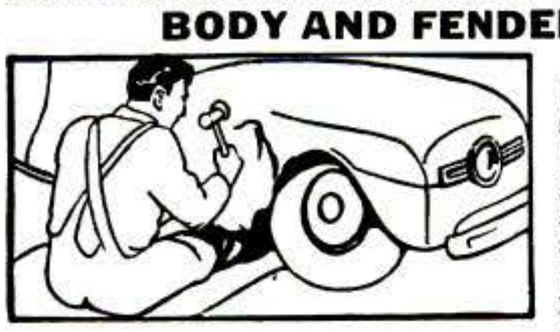

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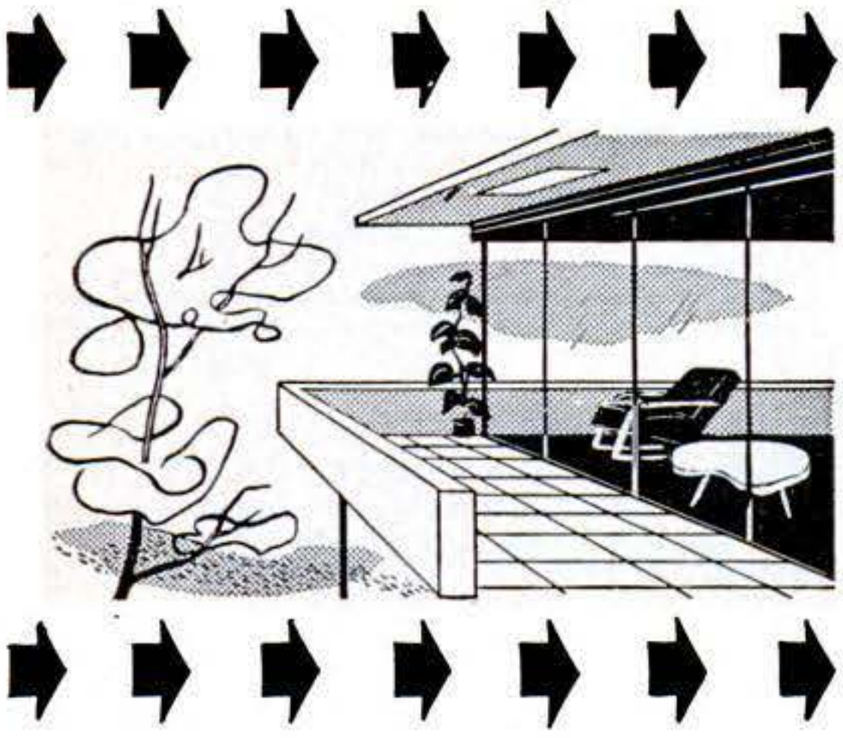

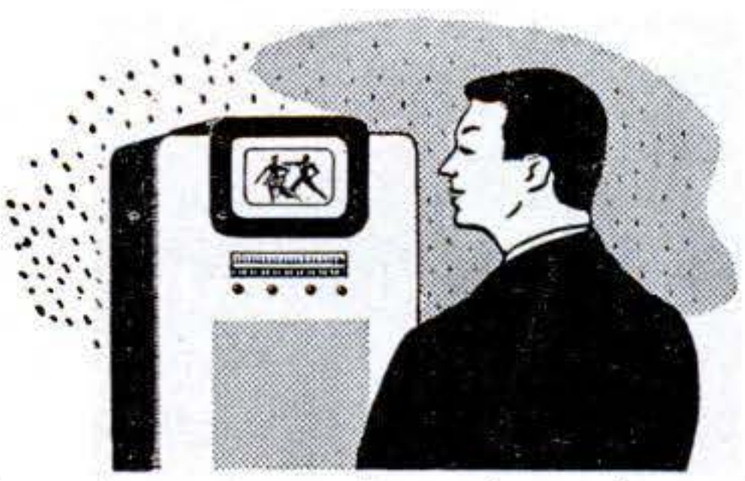

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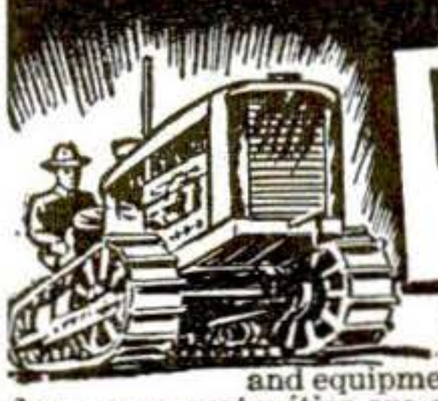

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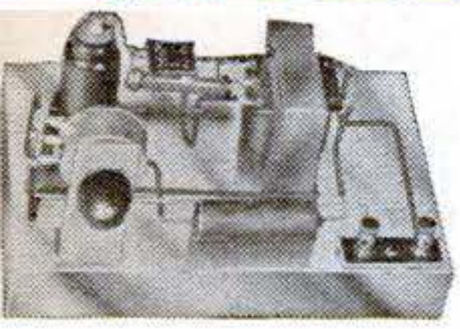

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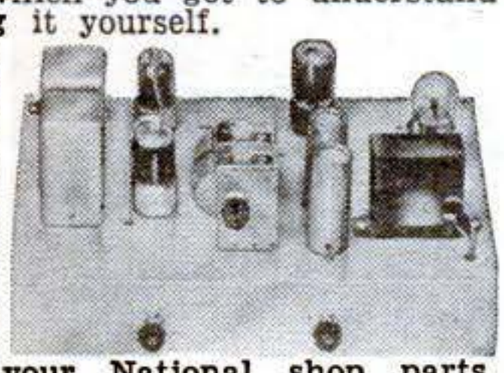

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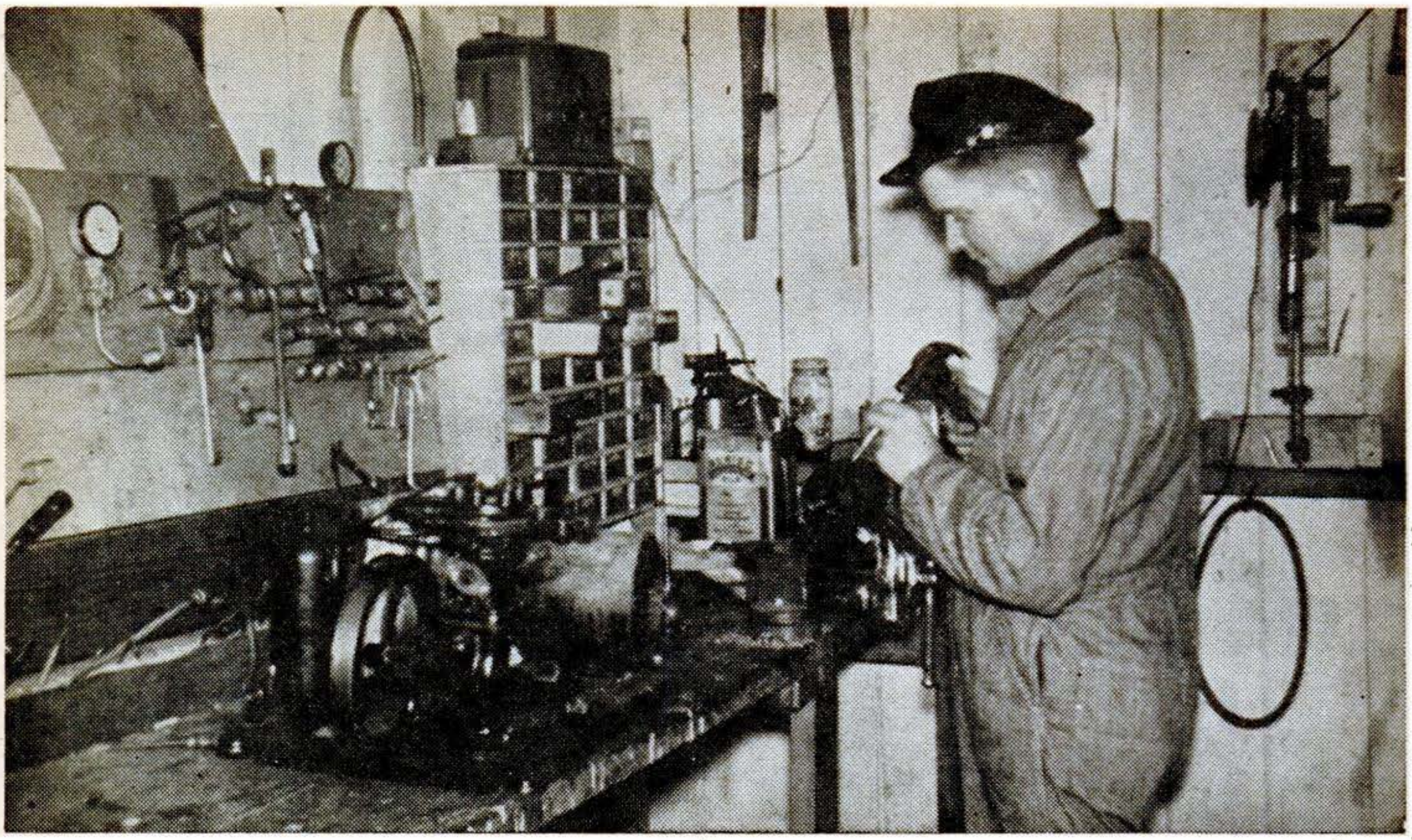

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By S. T. CHRISTENSEN

the "Fix-it-Man"

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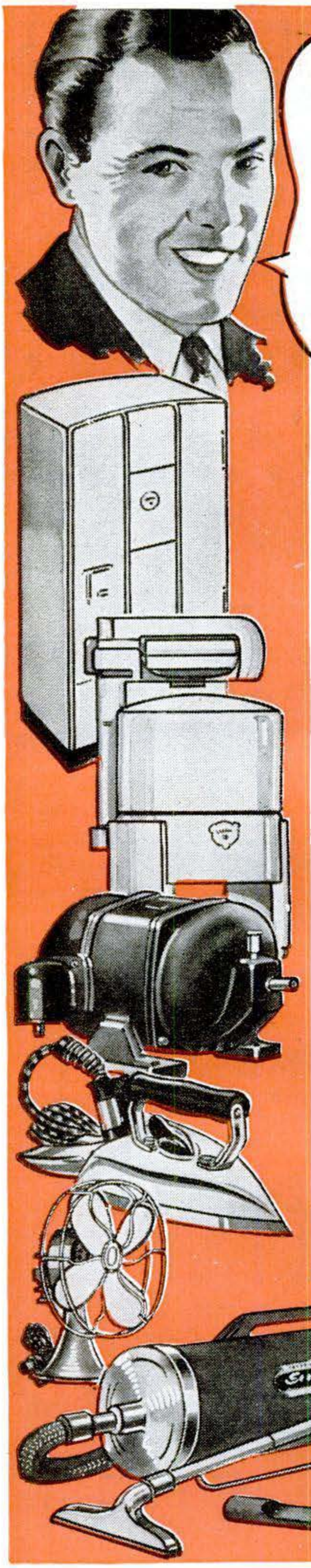

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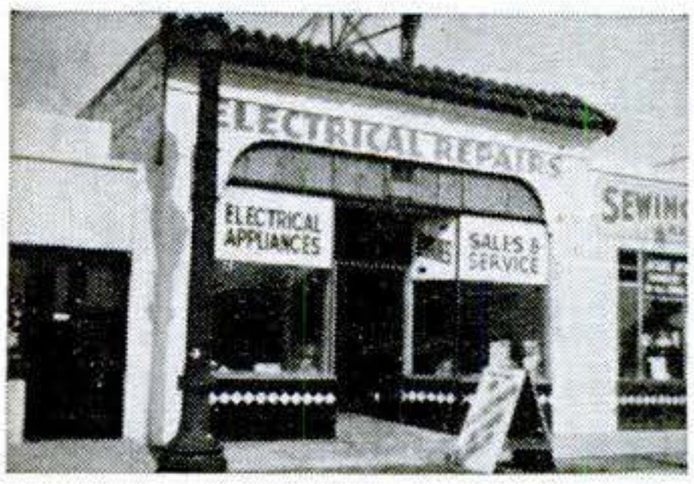

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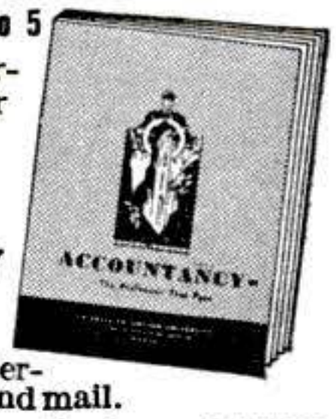

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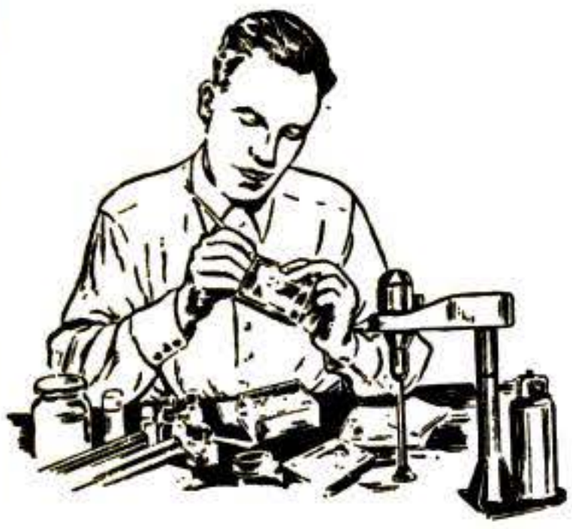

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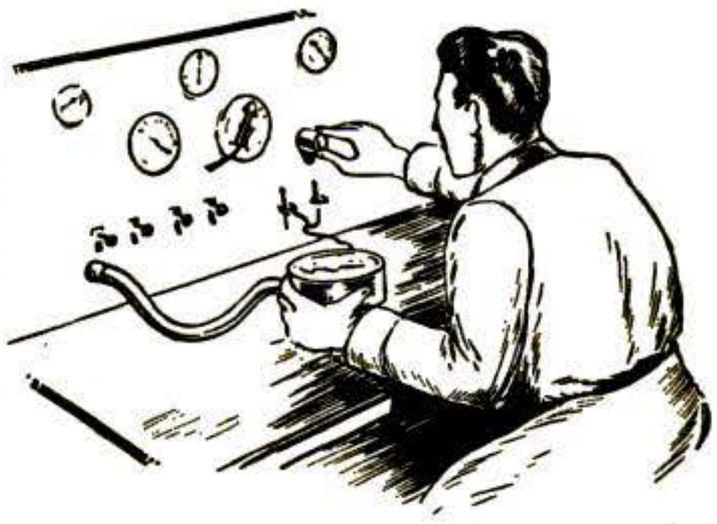

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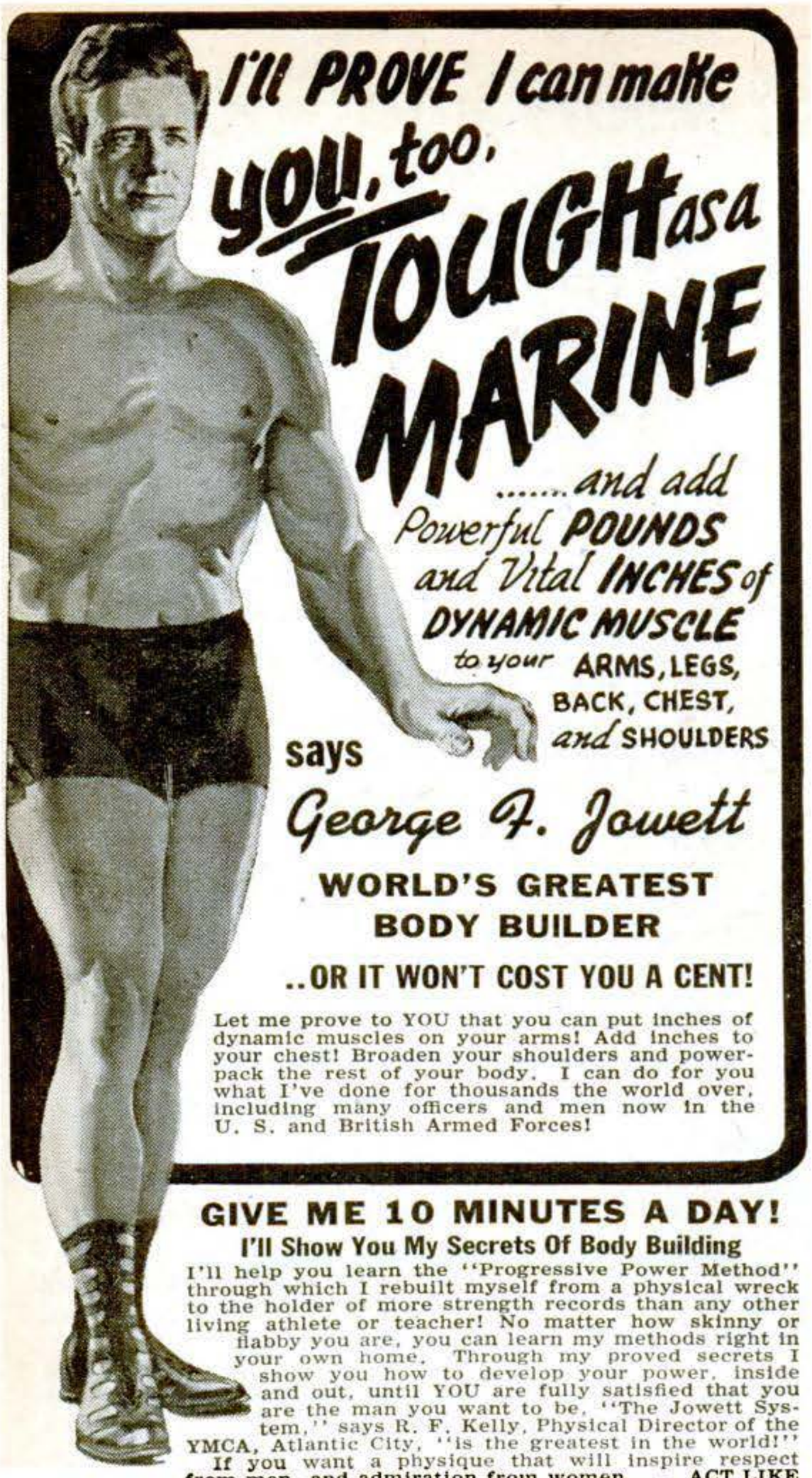

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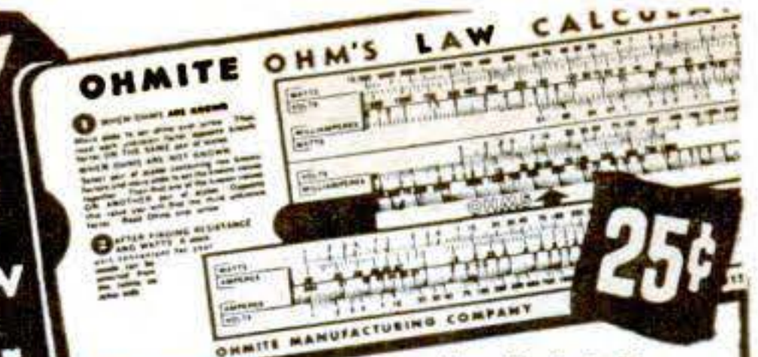

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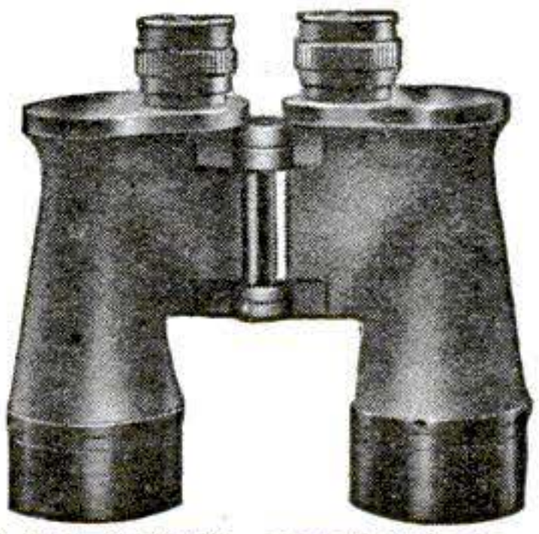

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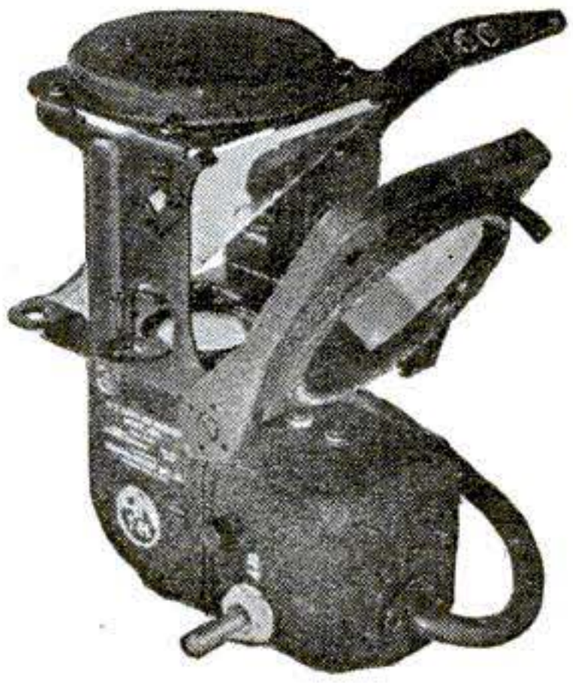

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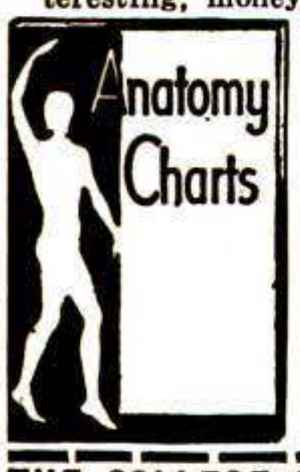

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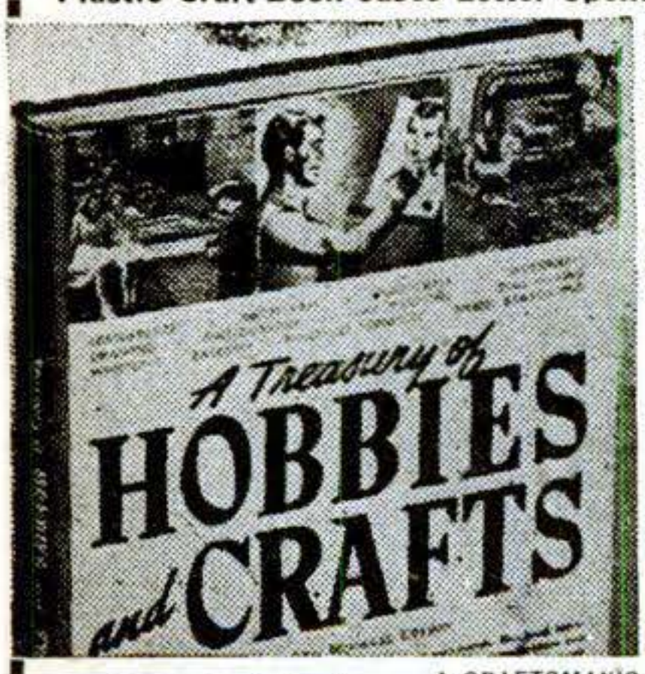

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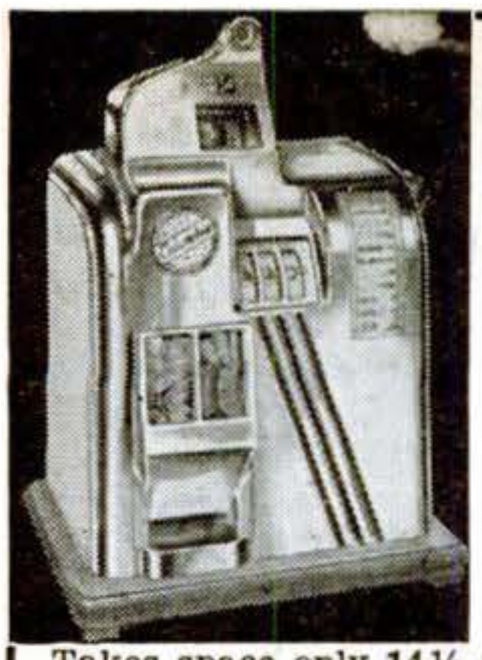

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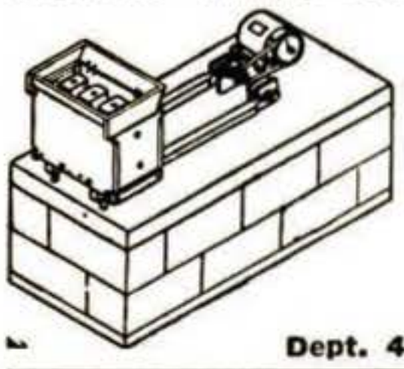

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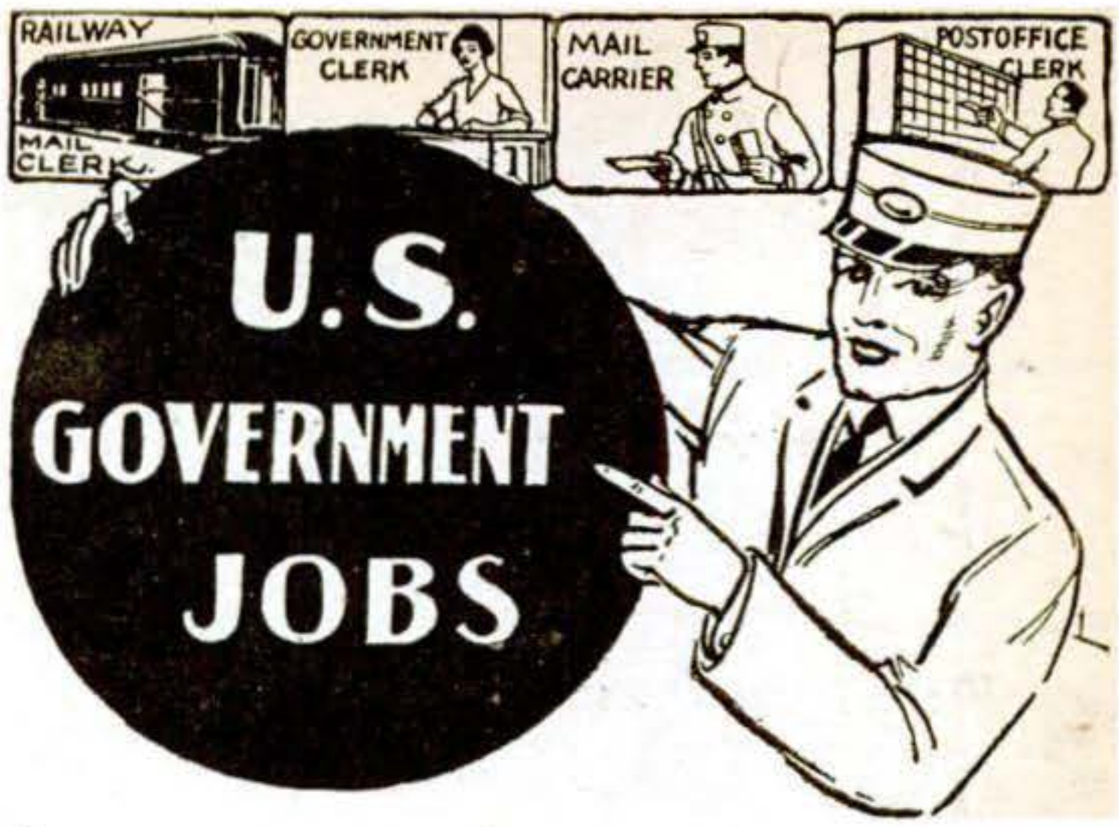

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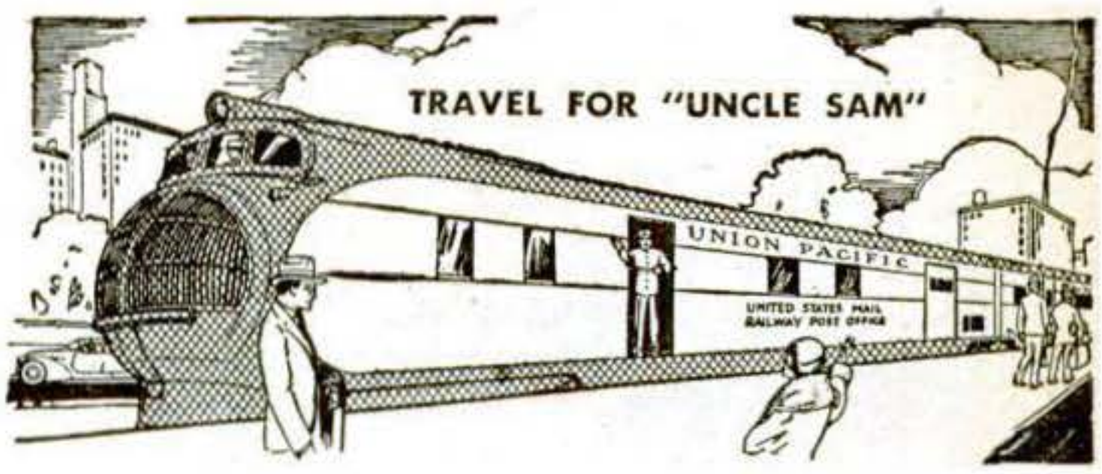

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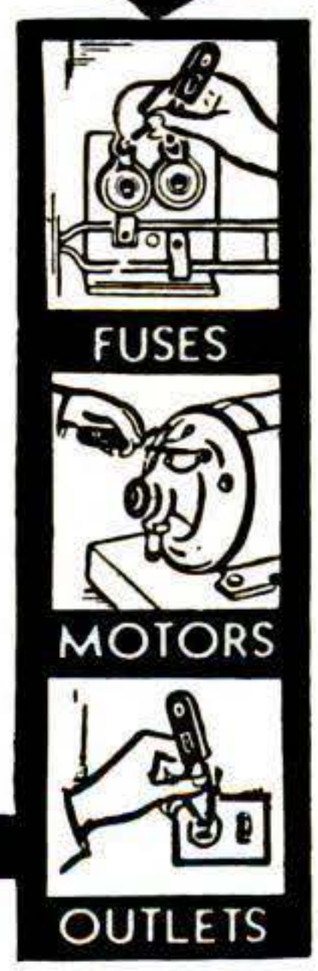

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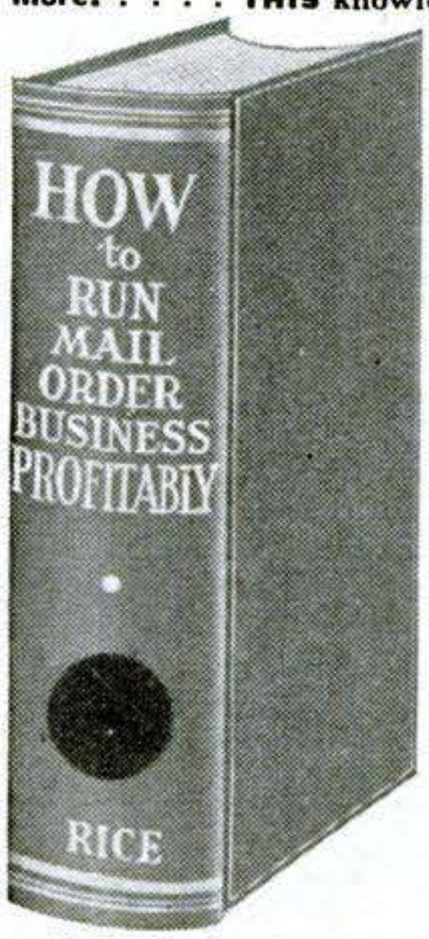

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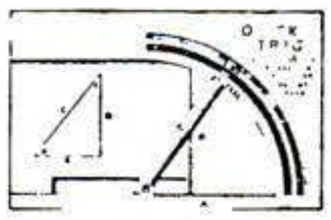

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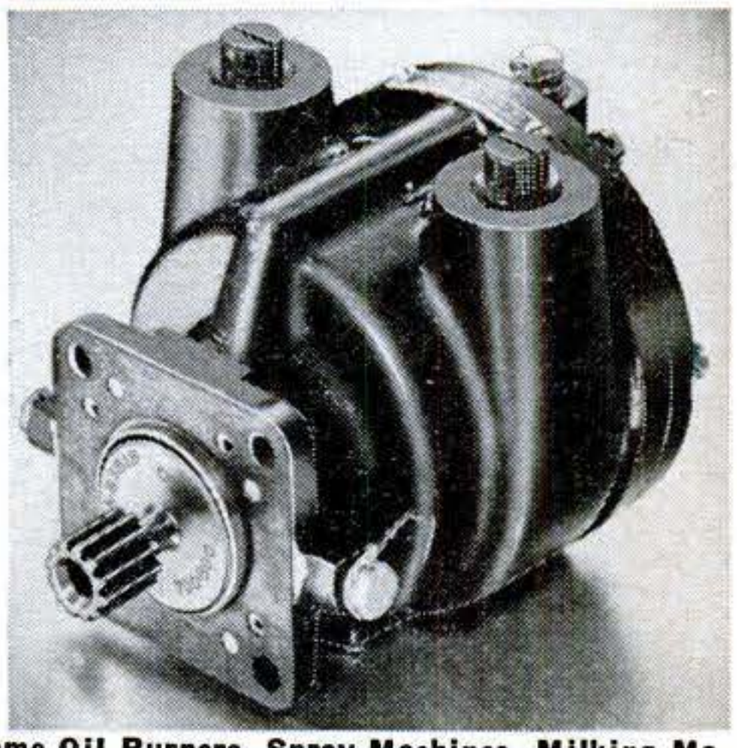

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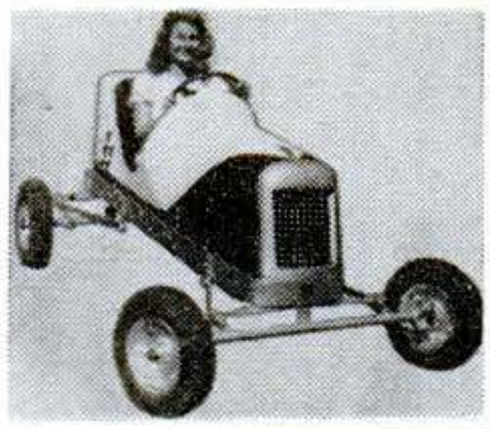

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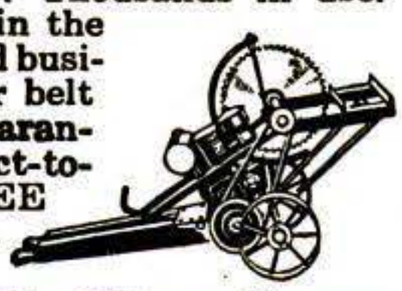

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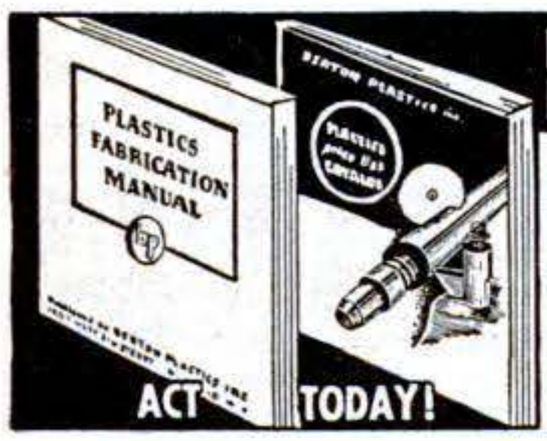

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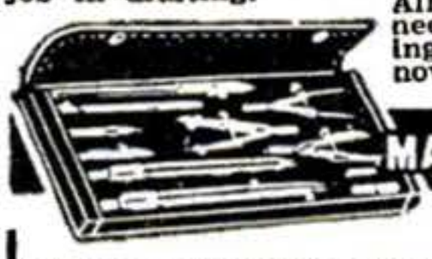

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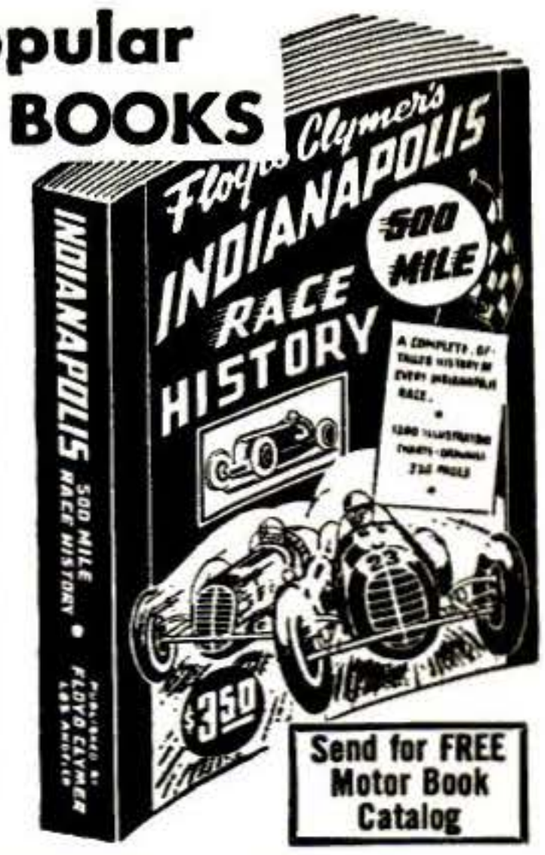

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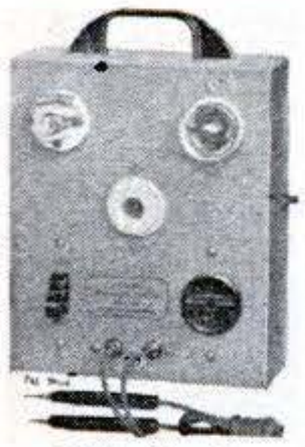

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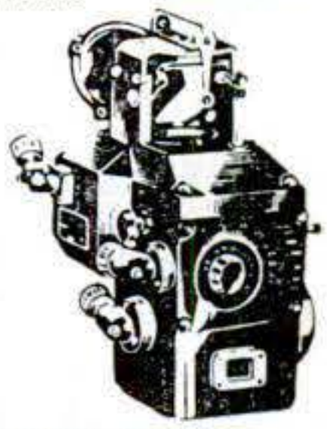

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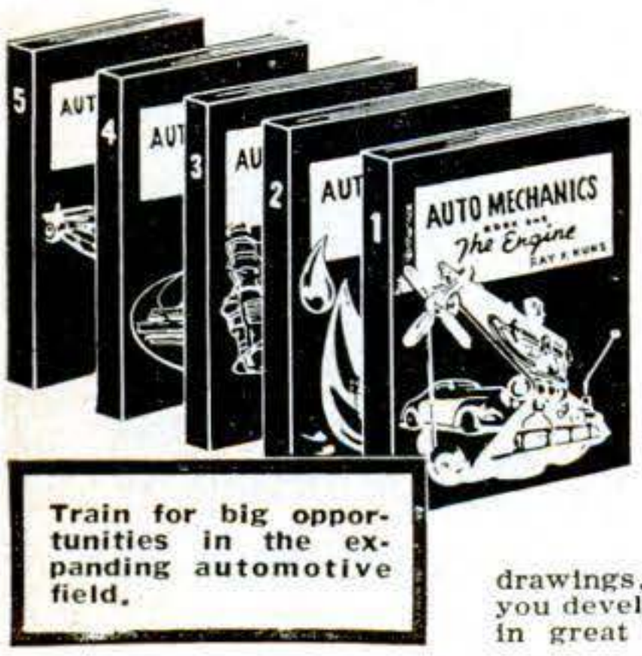

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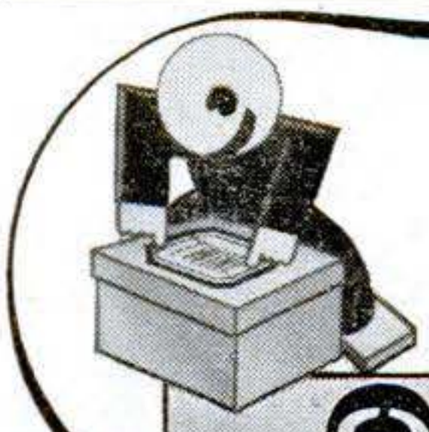

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a can, a jar
So all may know
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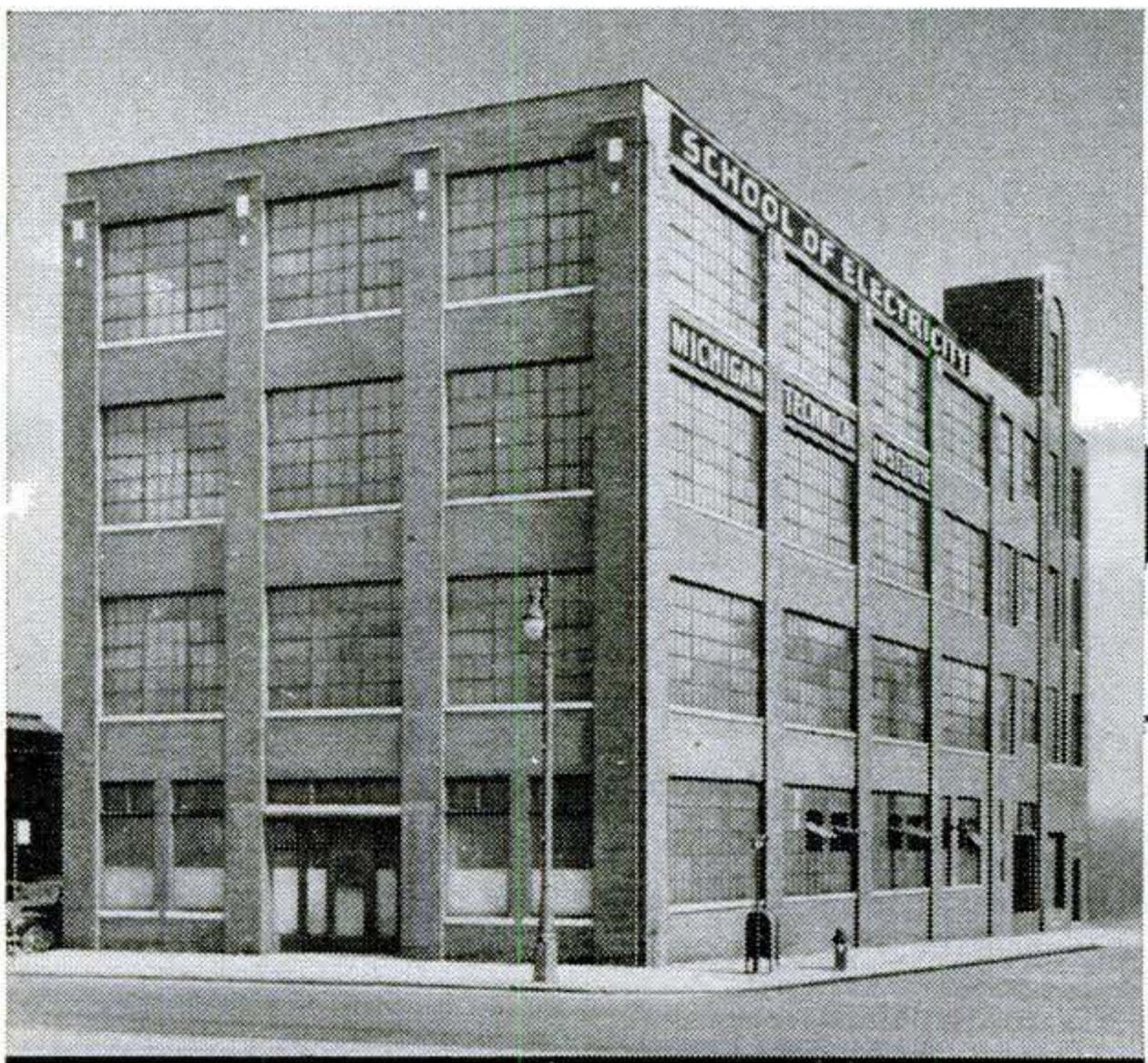

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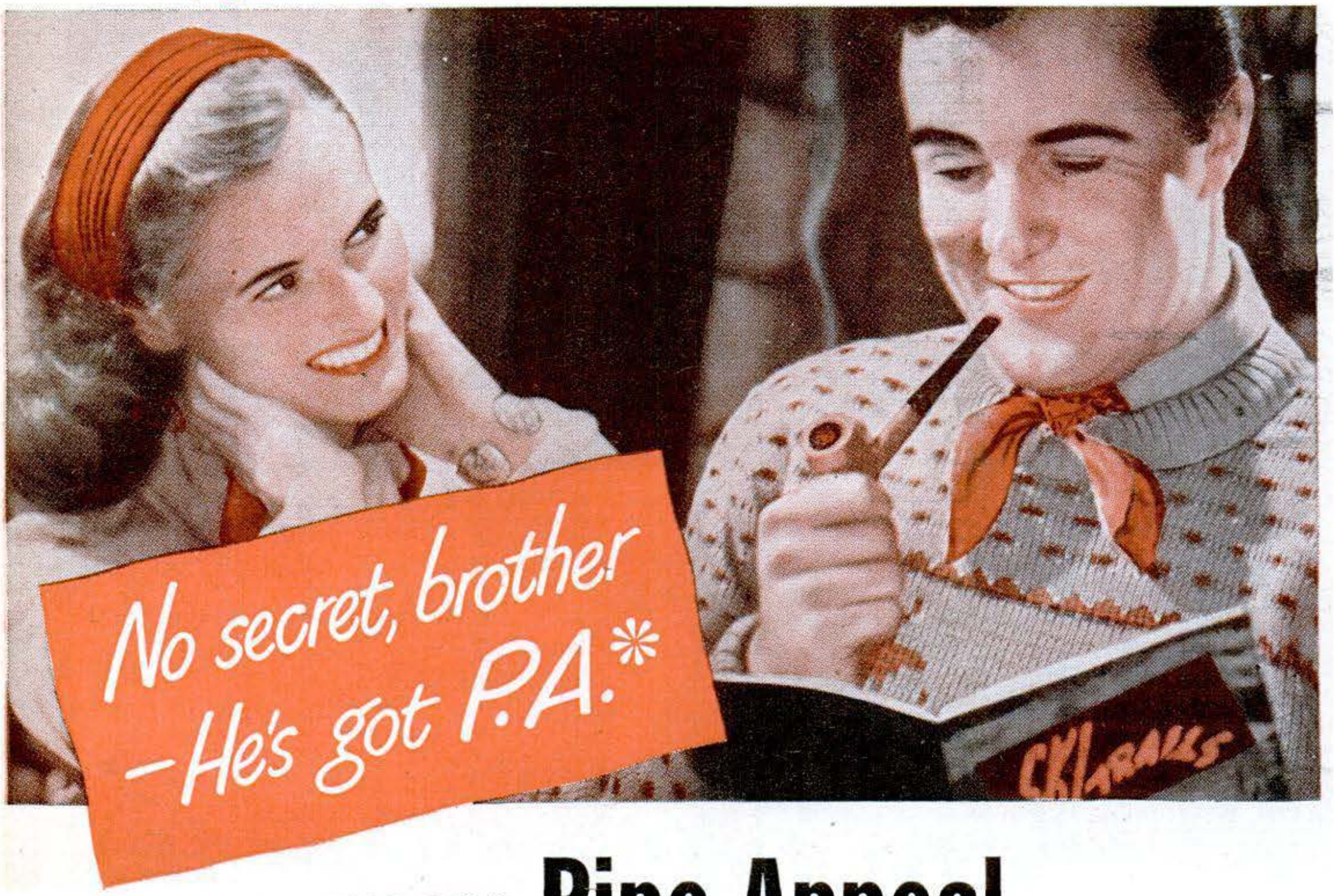

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Pipe Appeal is the rugged, masculine look of the man who smokes a pipe. Women go for it—just as you'll go for the comfort and joy of fine Prince Albert Tobacco.

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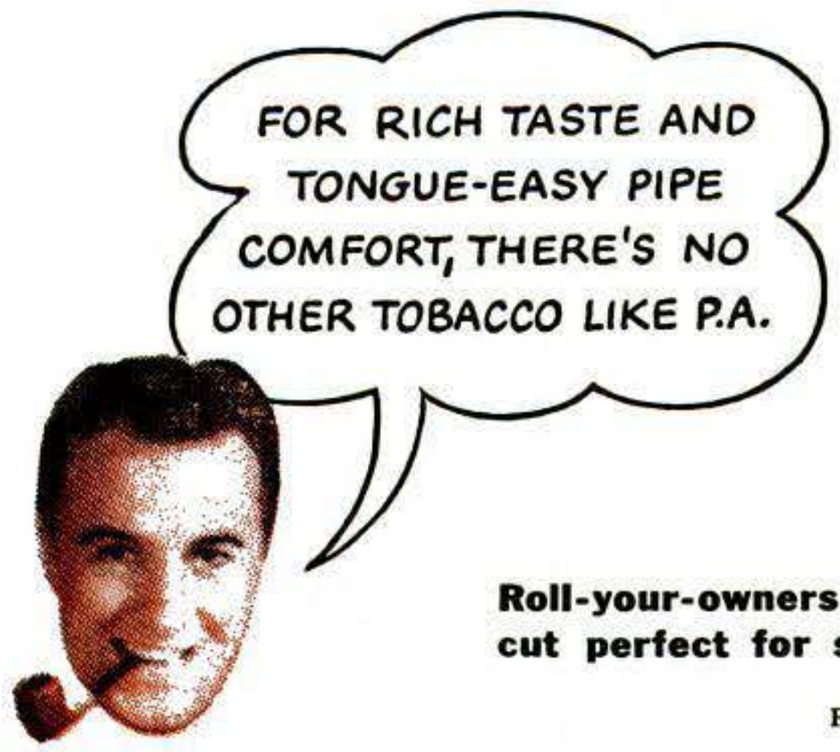
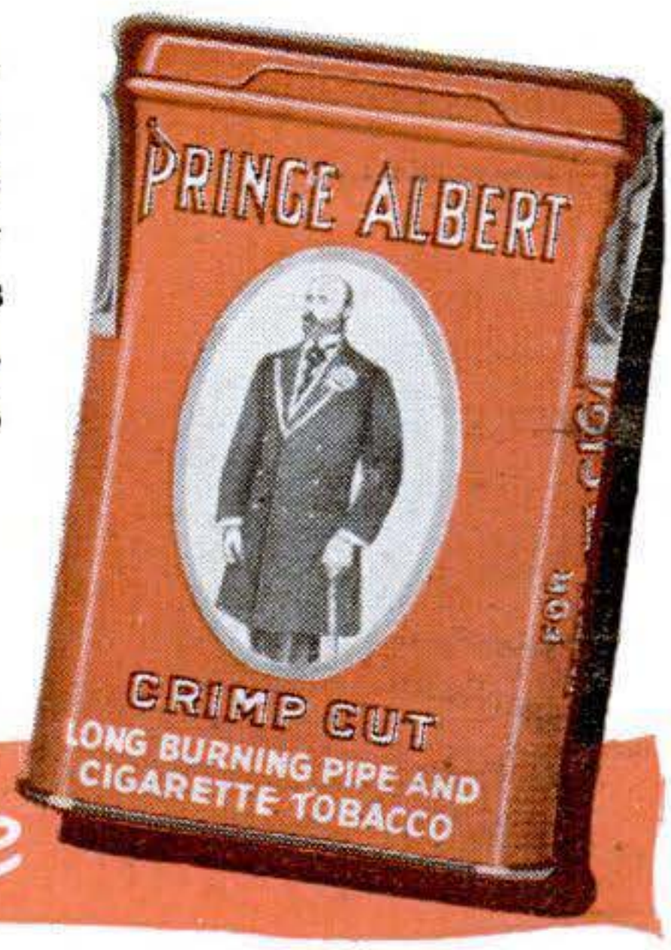


P. A. stands for choice smoking tobacco—Prince Albert. Fine, rich flavor that pipe smokers go for . . . specially treated to remove harshness . . . easy on the tongue! P. A. is crimp cut for easy packing, easy drawing.



Roll-your-owners find Prince Albert's famous crimp cut perfect for smooth, easy cigarette "makin's."

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The National Joy Smoke

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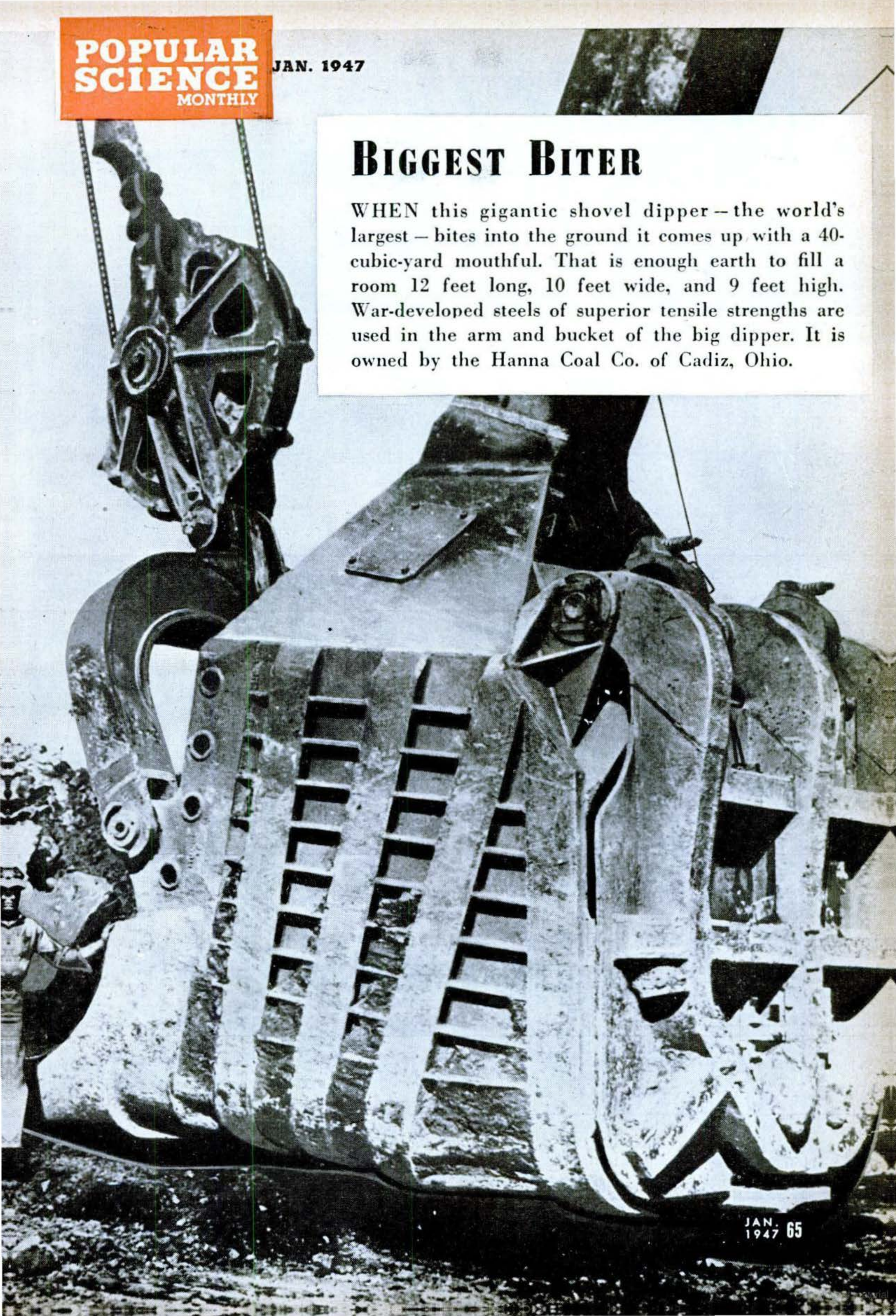
POPULAR SCIENCE MONTHLY JAN. 1947

BIGGEST BITER

WHEN this gigantic shovel dipper – the world's largest – bites into the ground it comes up with a 40-cubic-yard mouthful. That is enough earth to fill a room 12 feet long, 10 feet wide, and 9 feet high. War-developed steels of superior tensile strengths are used in the arm and bucket of the big dipper. It is owned by the Hanna Coal Co. of Cadiz, Ohio.



here come the

NEW FIRE ENGINES

Faster, huskier and better-designed, they will help curb rising losses —and steal the smoke eaters' show.

By DEVON FRANCIS

THE nation's smoke eaters, like actors, love an audience, so it's easy to guess how they'll feel when they see the spanking new fire engines now going into production.

They will sputter and stare, and well they may.

For the crews of the first new postwar fire wagons will ride inside. A man won't be able to stand on a running board, hanging on with one hand while worming the other into his coat, as the truck hits 50 m.p.h. Moreover, when the new "aerials" go into service, the tillerman—that magnificent, muscled figure who wrestles the steering wheel on the back end—will be out of a job. He won't be needed. Some of the trucks will sport enclosed cabs, and what fireman can properly ride to his work unless he is in the open, in full view of his audience?

The trucks with the shrieking sirens and red flasher lights will be far simpler to operate than any equipment designed since fire departments were motorized some 35 years ago. A kid will be able to work the controls and make it look easy.

The firemen will grouse and lob tobacco juice at their spittoons until they learn more about this new equipment. Then, gradually, they will discover that a new day in fire fighting is dawning. For the first time, equipment to fight fires is being made for more than a rough purpose. No longer are trucks being built as trucks and then loaded as an afterthought with pumps, ladders, life nets, axes, suction-hose strainers, and chemical bottles. The postwar fire truck will be an integral unit, designed solely to fight fire.

It is high time. The news on fire losses is not good. It may become worse this winter, the season that is always the year's peak period for fires. The 15,000 fire departments in the United States are sleeping restlessly

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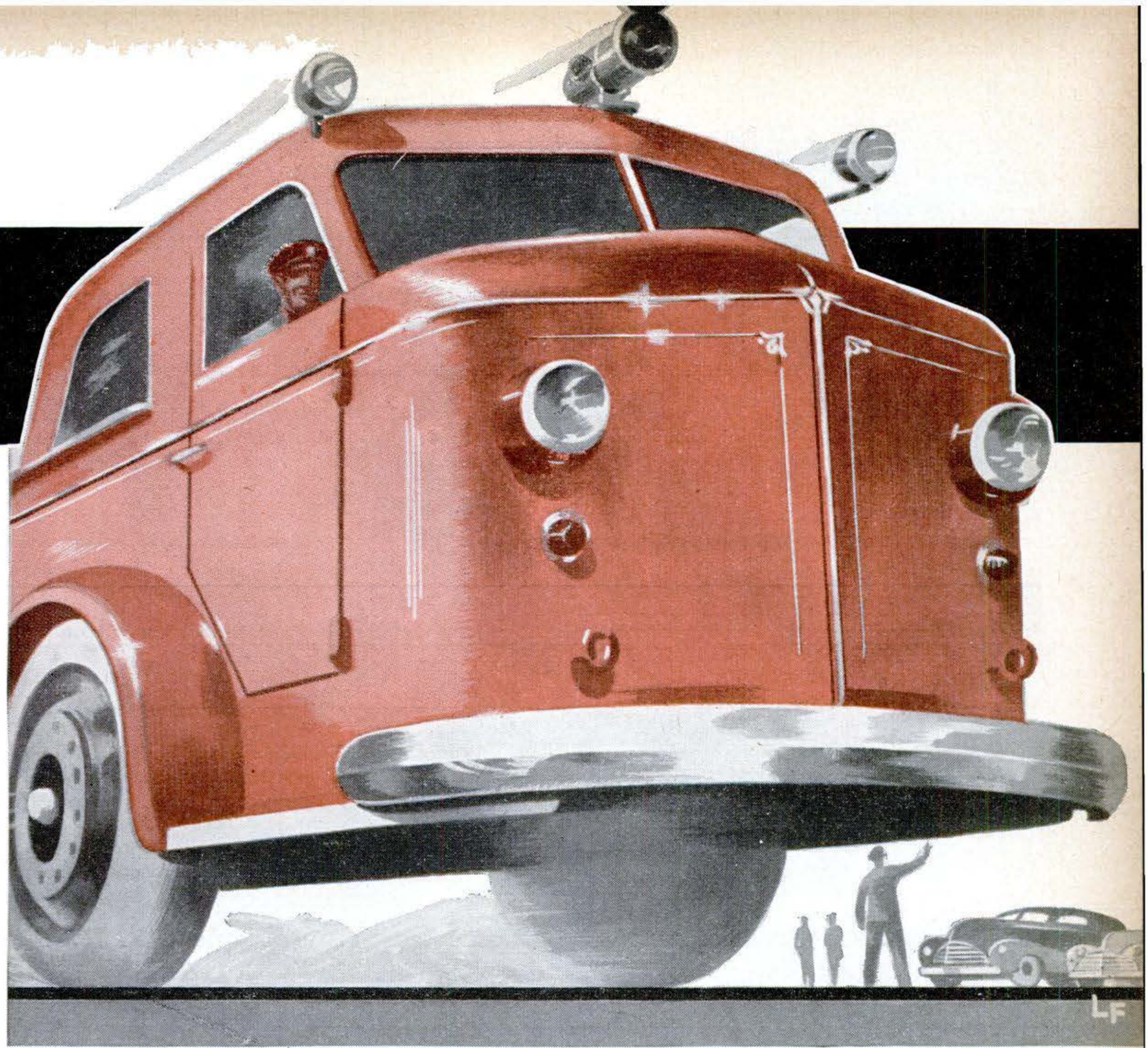

these nights. To the mass of jerry-built, highly inflammable war structures, tens of thousands of equally inflammable temporary houses are being added.

The fire engine is the community's chief protection against destructive fire. To the householder, his fire department is especially important: 85 percent of all fires occur in homes.

While the news of fire losses is bad, that of fire-fighting equipment is good. The new fire wagons will tend to equalize the odds between fire and the men who must be girded 24 hours a day to quench it. That has been the goal of the leading fire-engine manufacturers—the American-La-France-Foamite Corp., of Elmira, N. Y.; the Seagrave Corp., of Columbus, Ohio; and the Mack International Motor Truck Corp., of New York. Today, American-LaFrance is bellwethering the field with its new aerials and pumpers and its more complicated "quads" and "quints," now coming off production lines.

All the equipment is faster, some of it by as much as 25 miles an hour, than that produced before the war—so the new trucks can get to fires quicker. They also have better brakes. These assure more safety to firemen and motorists in steadily growing traffic. In addition, the trucks have a shorter turning radius, permitting them to get in and out of narrow streets and alleys where old equipment could not go.

Pumpers throw water under greater pressure. Water formerly was put under pressures of 75 to 100 pounds for a throw of some 30 feet. Now pressures run up to 250 pounds, and an effective stream can be directed at a fire twice that far away. Better yet, the pumps deliver more water. More water means more heat-absorbent liquid on

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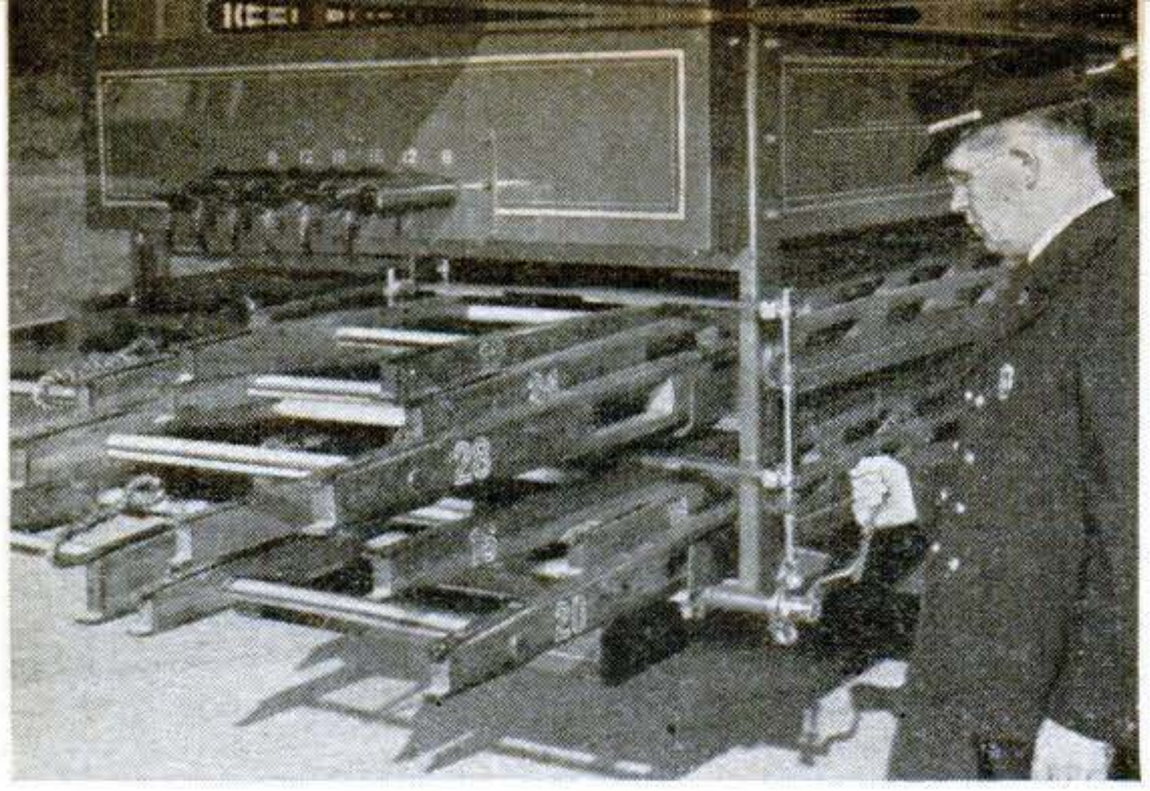
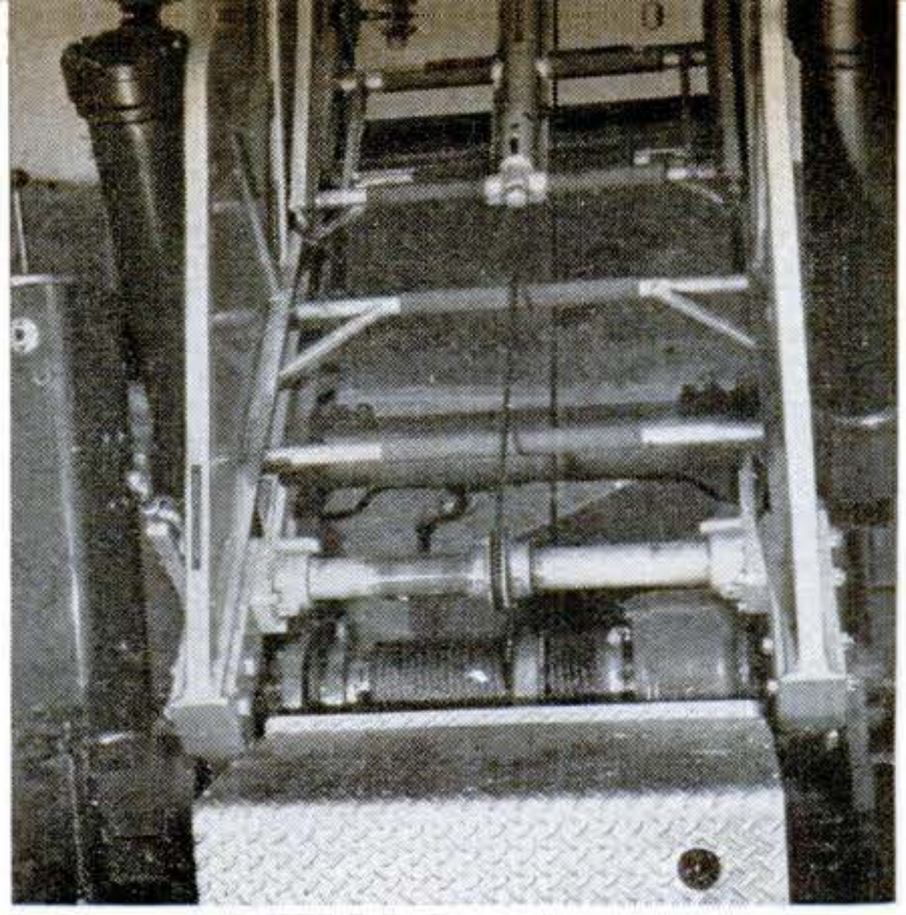
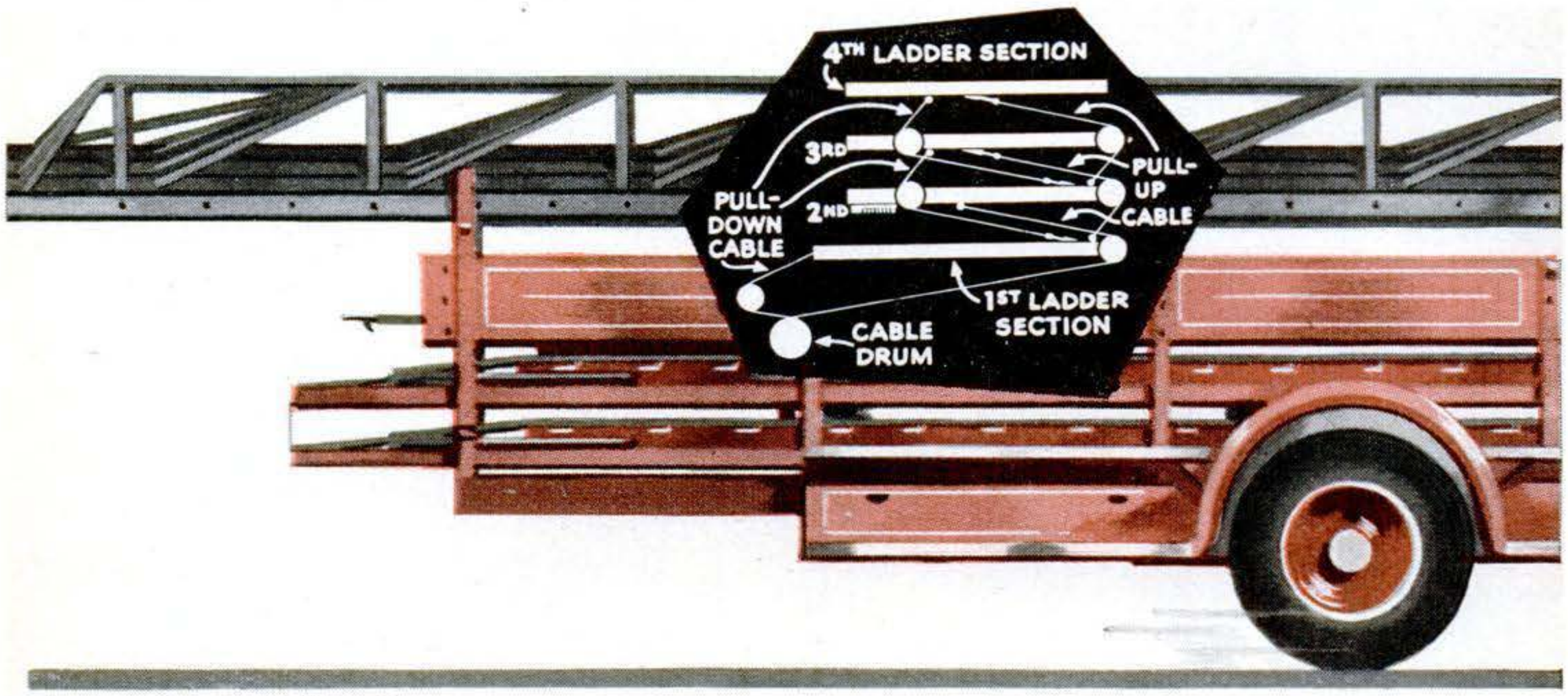


The American-LaFrance aerial below carries a nest of scaling and roof ladders (shown in photo above). Fireman is releasing locking mechanism that holds the nested ladders firmly in place while truck is in motion.



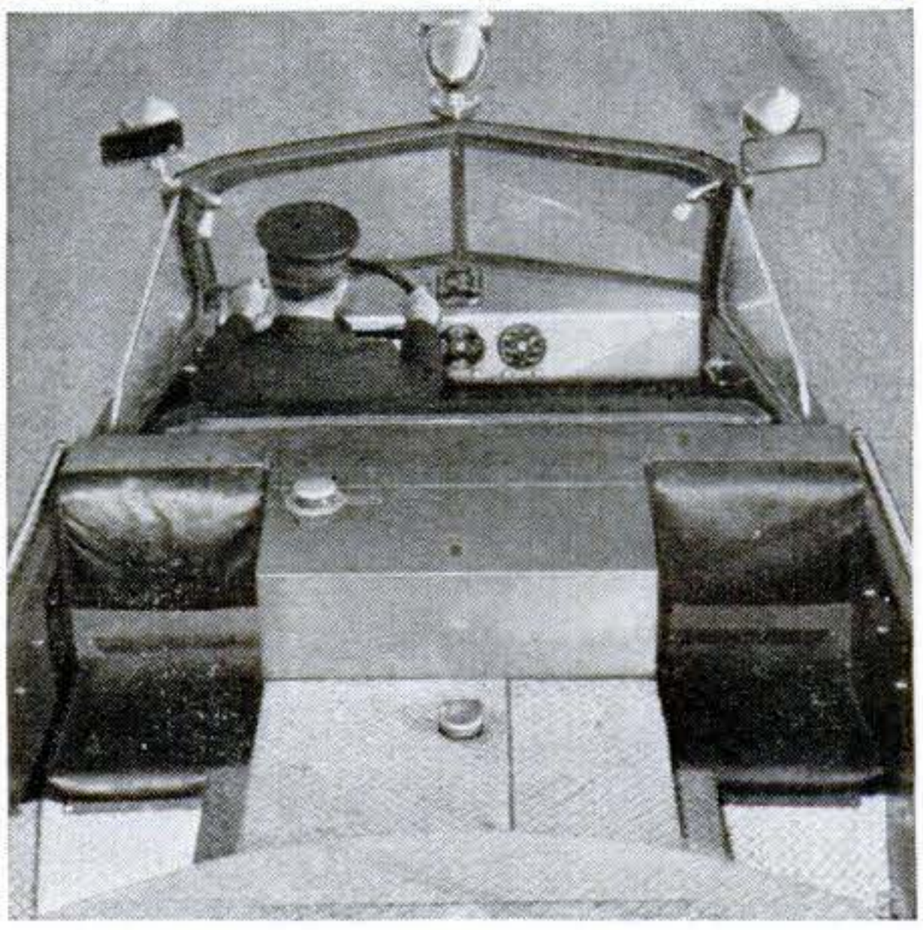
Four-section extension ladder rises 85° from horizontal, rotates through complete circle.



PSM photos by W. W. MORRIS

This truck's sectional life net (shown below) folds in four quarters. Special compartment in which it fits is an example of added space available on new engines.

Putting engine amidships (under hood in foreground) increases stability and aids steering.



a fire to lower its temperature and put it out.

Pumpers are the pampered centerpiece of every fire department. The National Board of Fire Underwriters—which considers a community's vulnerability to fire and its ability to fight fire, and rates insurance risk accordingly—has equipment standards encompassing pumpers that can deliver anything from 500 to 1,500 gallons of water a minute. All of them are base-rated at

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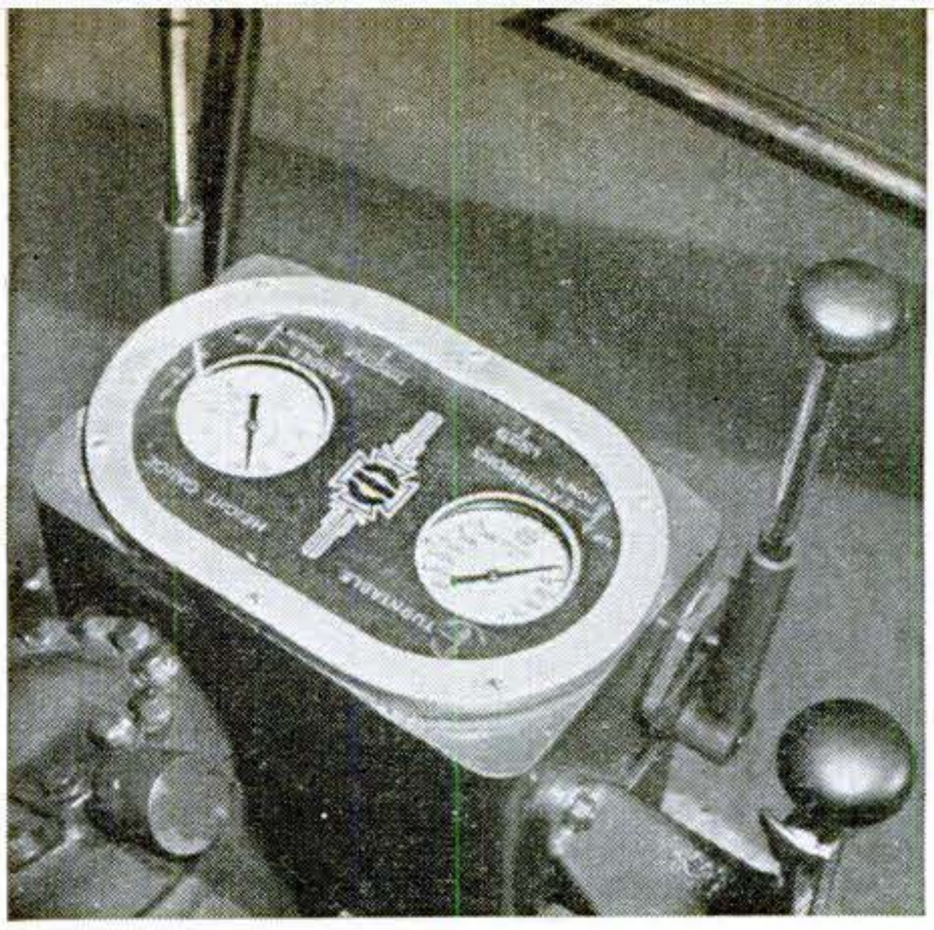
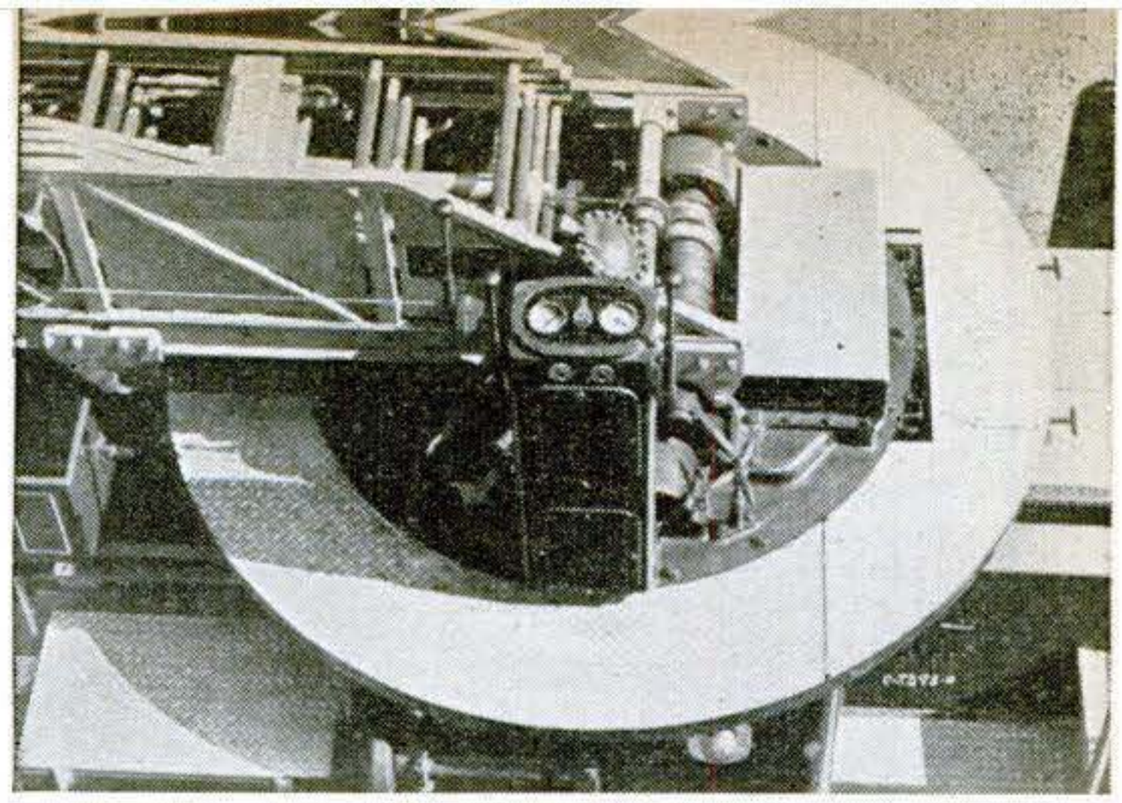
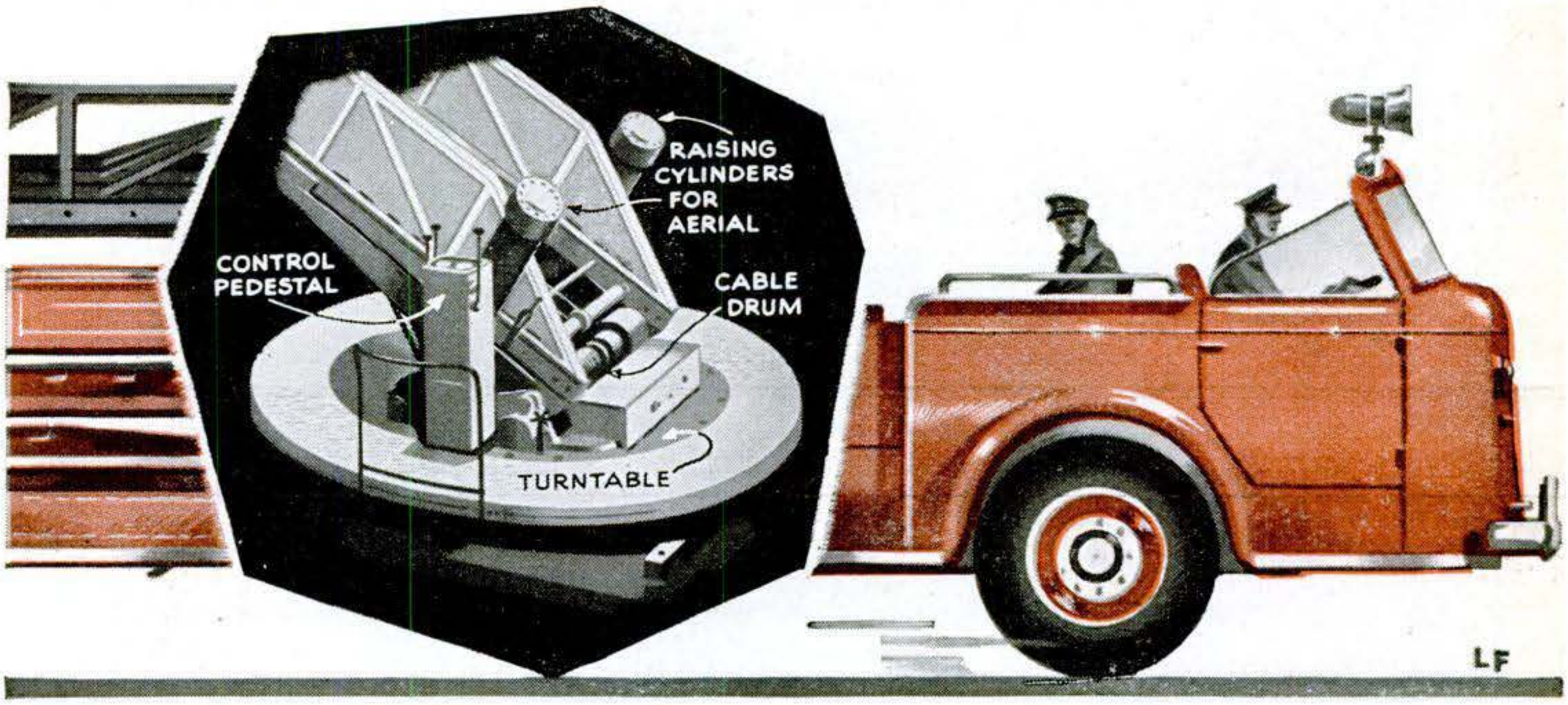


Levers operate ladder, its sections, and turntable. Gauges show ladder height and pressure.

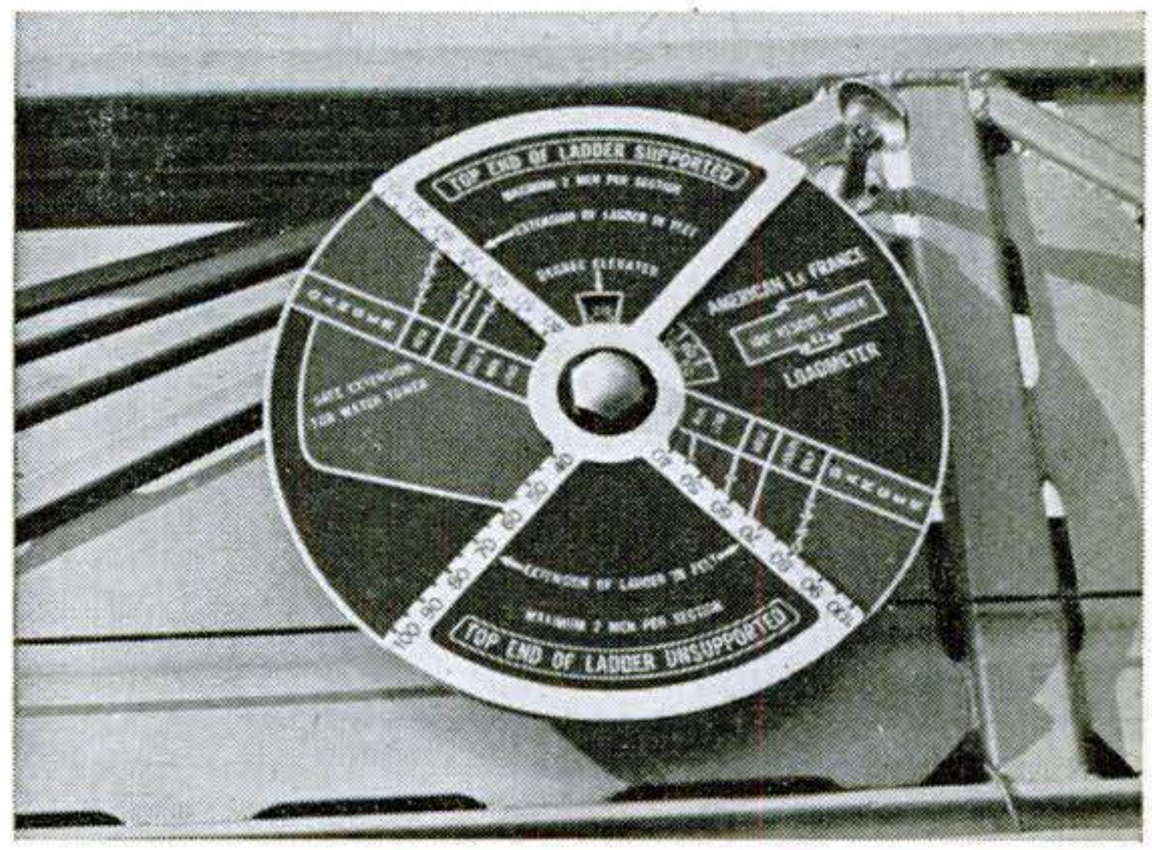


Base of extension ladder is flanked by the hydraulic cylinders that raise and lower it. They contain oil with a "pour point" of –40° F. for cold-weather work. Ladder has hydraulic and mechanical safety devices.



Crew seats inside bodies of new trucks may be more prosaic, but they assure greater safety.

Gravity-operated load meter tells at a glance how much weight ladder will carry at any elevation and degree of slant, whether the upper end is supported or free.



120 pounds' pressure. The pressure governs the *range* of the streams thrown, and the capacity (gallons a minute) governs the *number* of streams that can be directed at a fire. A 500-gallon pumper supplies two good streams, under normal conditions; a 1,500-gallon pumper, six streams.

The new equipment has many advantages besides greater ability to throw water. Power plants are more accessible for serv-

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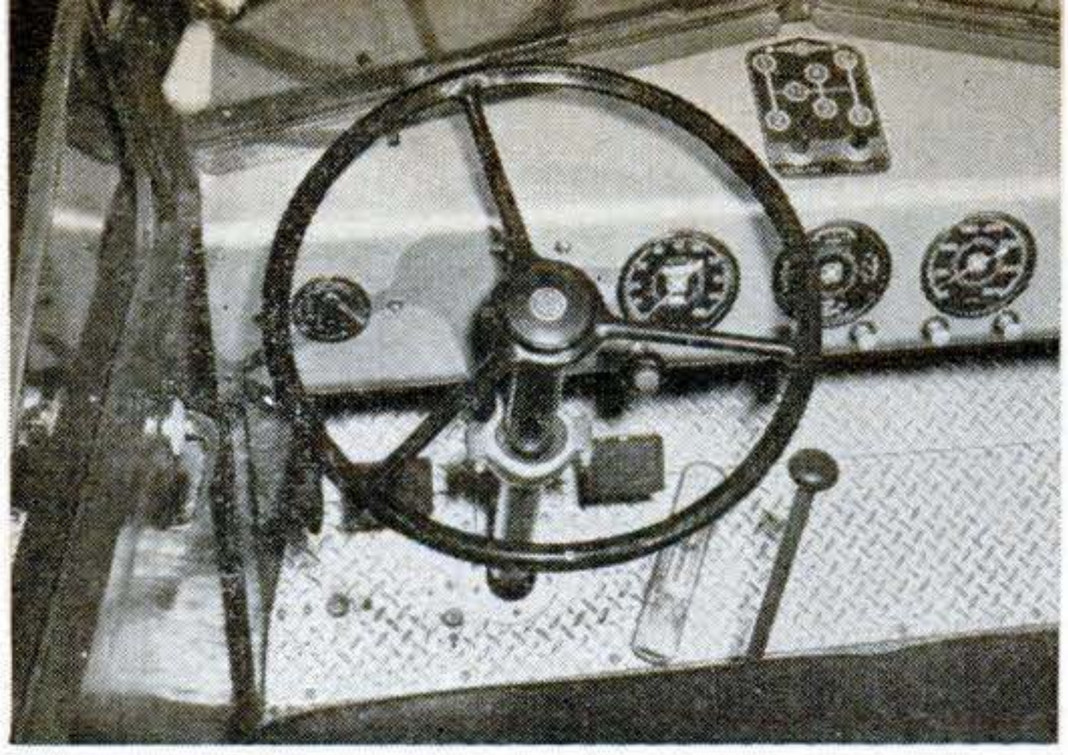
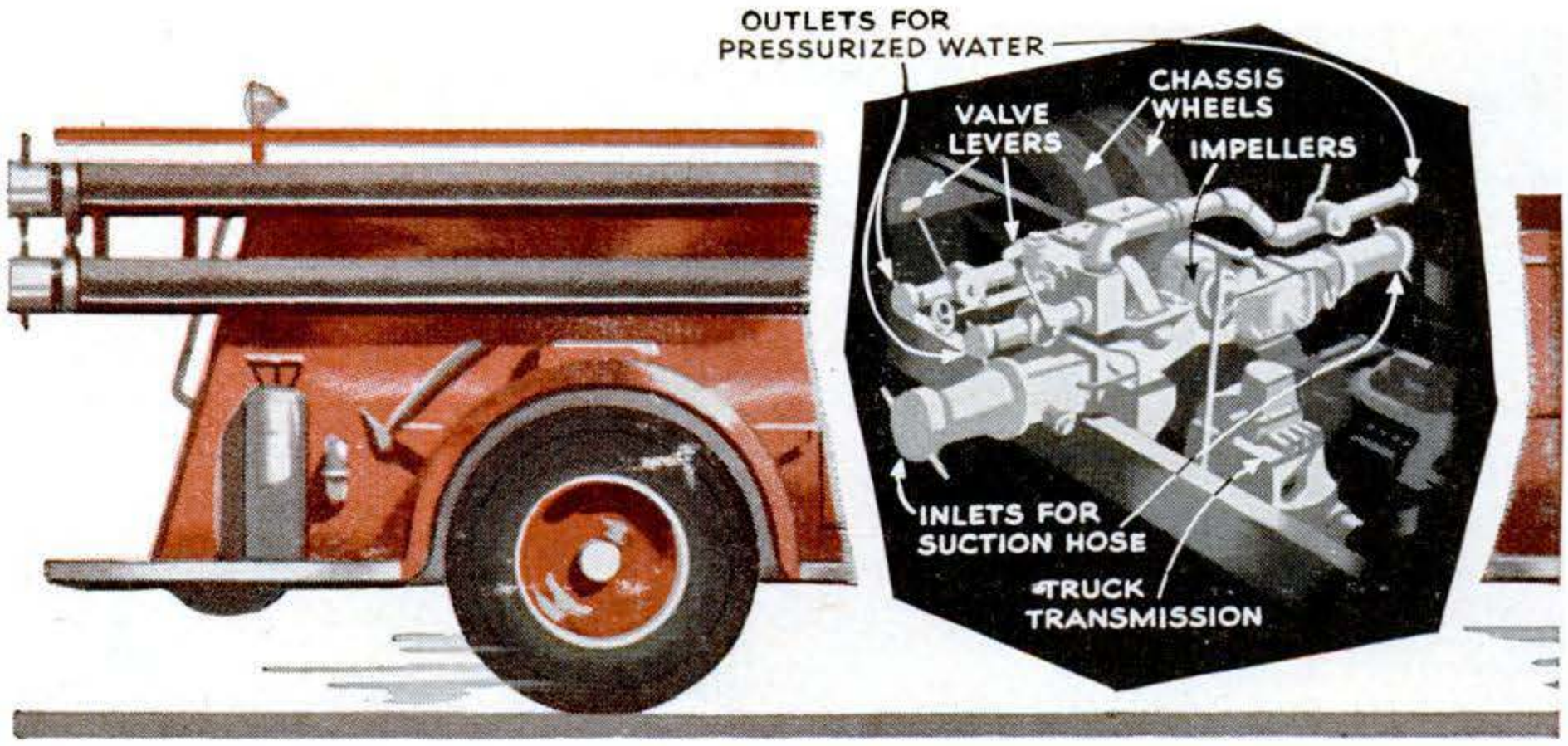


Drivers of the American-LaFrance pumper below use conventional controls (pictured above), plus tachometer and siren buttons. Gear diagram is on dash.

Accessibility of engines in new pumpers simplifies maintenance and speeds emergency repairs. The hood can be entirely removed in less than a minute.



This pumper's "deluge gun" (below) has to rest on ground because it would take six men to hold it. Maximum pressure for two men is about 70 lb.

Equipment on pumper's rear deck (below) includes strainer for suction hose (being lifted from its mounting), chemical extinguisher, nozzle stand, ax.

icing. A better distribution of loads on the trucks increases stability and permits easier steering. Hose capacities have been stepped up. There is more compartment space for the fire fighters' specialized tools.

But what will win over the die-hards in the business, when they have time to digest the idea, is better visibility for the men who drive the trucks. *Far more firemen are killed and injured in traffic accidents racing to fires than in actually fighting fires.* Now the long hood has been removed from the fire-wagon driver's line of vision, and the engine is amidships. Sitting in the driver's

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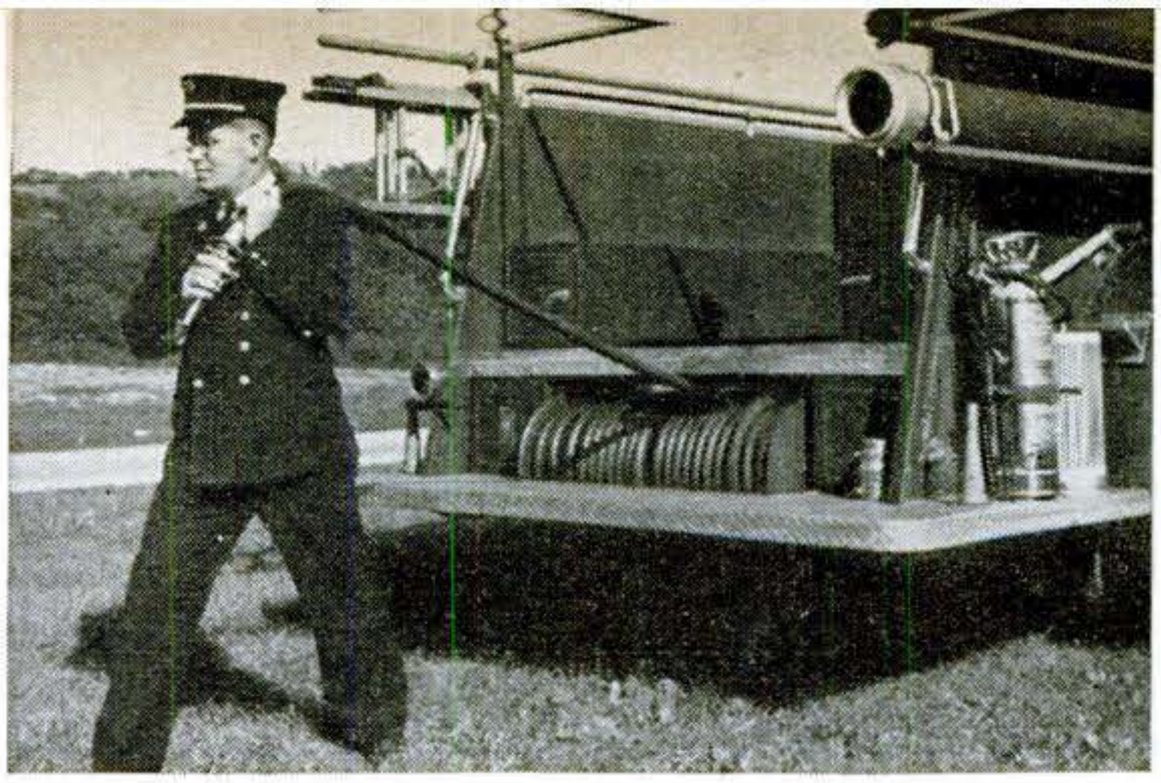
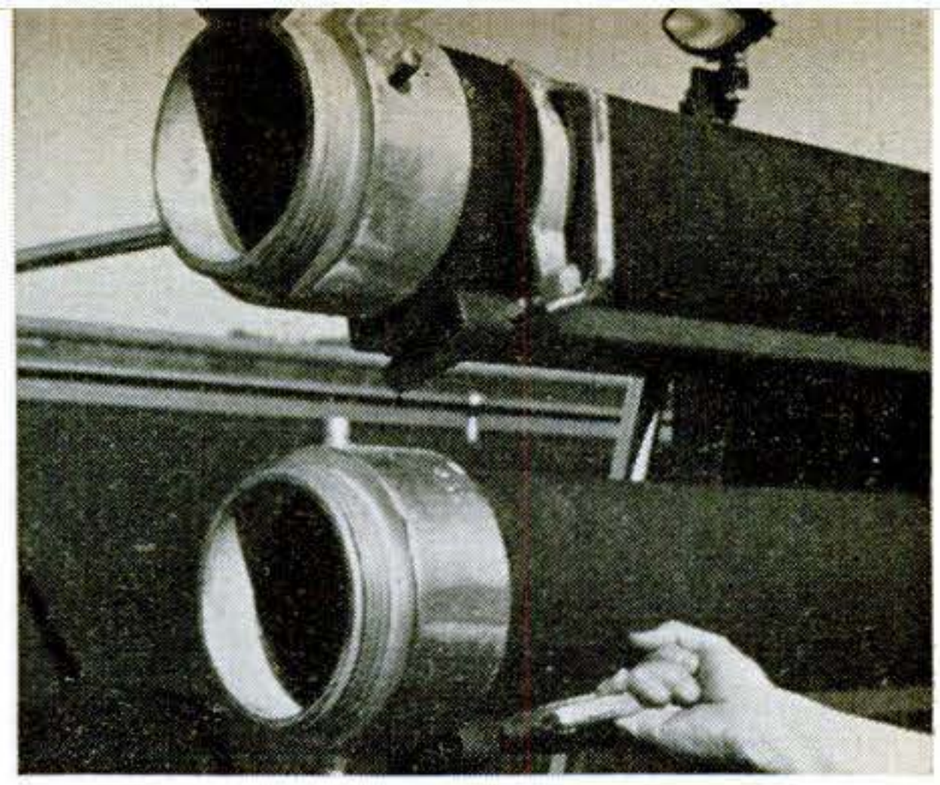
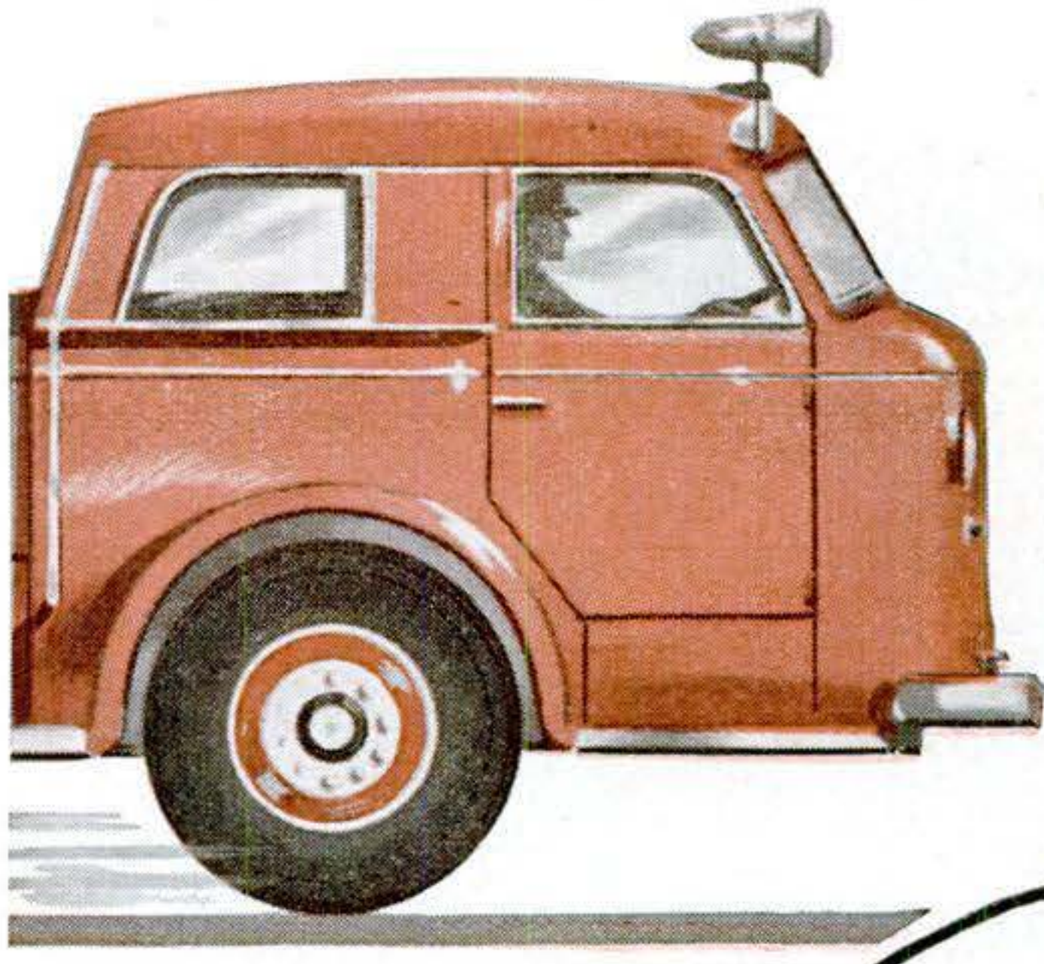


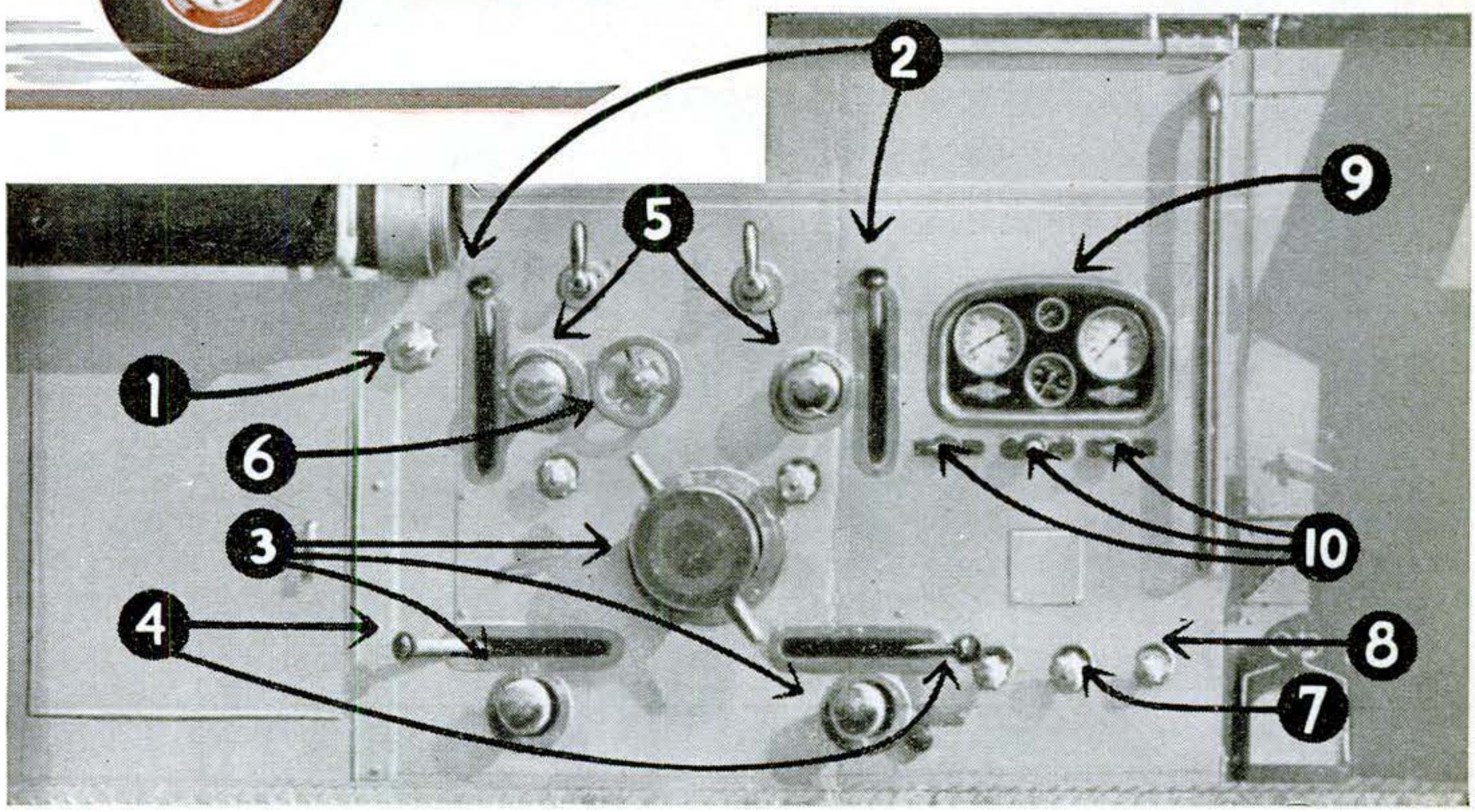
Booster hose takes water from a 150-gallon tank for small fires. Its name goes back to the days when acid and soda, added to water, provided the pressure.



Twin suction hoses can be dismounted by pulling the spring-loaded clamps. In old-fashioned mountings, they had to be withdrawn from cradles lengthwise.



Control panel (below) on the side of a new pumper includes (1) valve for booster hose; (2) discharge outlet controls; (3) suction hose inlets; (4) valves for suction inlets; (5) hose outlets; (6) change-over valve for parallel or series operation of pump; (7) valve governing engine speed by pressure; (8) control of cooling line for pump transmission; (9) gauges showing oil pressure, r.p.m., water-discharge pressure and hydrant pressure; (10) engine throttle, governor control and primer for pump. (More pictures of new fire engines, both pumpers and aerials, appear on pages 104 and 105.)



compartment is like sitting on a front porch.

Putting the firemen inside the trucks while going to and from fires makes sense, too. After the smoke eaters have whipped a winter fire and clanged back to the station house in old-style equipment, there is always a wave of illness among them. It is caused by breasting the wind in soaked clothing. When men are on sick leave, a community's fire protection sinks accordingly.

The new equipment is going to mean savings to taxpayers, because less equipment will be needed.

The fire-equipment manufacturers are

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making a conscientious effort to produce trucks that are simple to operate, for a very good reason: Out of those 15,000 fire departments in the United States, *only a tenth are paid professionals.* It takes little instruction to learn to turn the knobs and pull the levers on the new trucks. Pumps can be run dry without damage because they turn on ball bearings. Governors take care of varying loads imposed on the pumper engine and, perhaps more important, guard against overloads on hoses. (Excessive pressure can turn a hose into a writhing flail capable of maiming or even killing a fireman.)

These safeguards will be helpful to professionals as well as volunteers in the fluster of getting organized to fight fire losses that are steadily spiraling upward. In 1940 the nation's fire bill in paid losses alone (excluding losses where no insurance was carried) was almost $286,000,000. In 1943 it was $373,000,000, and in 1945, more than $484,000,000. That doesn't mean there were a lot more fires; it does mean that there were a lot more *expensive* fires. This was because the hazards got worse while the fire departments were suffering a loss of trained personnel, and also because fire-fighting equipment rapidly became outdated in the face of the hazards.

The present demand for new fire wagons is unequaled in the memory of the fire-fighting equipment companies. The reason for part of it is obvious: Communities couldn't buy them during the war. Another reason is a recognition of the shortcomings of what fire departments have on hand. One of the biggest cities in the country is still fighting fires with wagons equipped with two-wheel brakes. *Hand pumpers 75 to 100 years old still serve some American villages.*

Designing superior equipment to hack down the annual American fire bill and then getting on to the production lines is only a part of the job the manufacturers have to do, and they know it. They've got to start wooing the old-timers into using it.

American-LaFrance has something on tap that it's not sure it should even mention until the shock of the first postwar wagons wears off. It's a plastic cab. It can be bolted on in winter and removed in summer.

Panty-waist stuff!

THE LANGUAGE OF THE SMOKE EATERS

Aerial: hook-and-ladder wagon, generally equipped with a power extension ladder.

Back out: retreat from a hot spot.

Basket: strainer for suction hose.

Bed ladder: base of extension ladder.

Blue light: a youngster in the business who sits around the station house hoping for a fire.

Booster: small, ¾- to 2-inch hose, fed from tank.

Claw: forcible-entry tool.

Dodo: a boot (probationary) fireman.

First whip: driver of a hook-and-ladder or pump truck.

Fly, or fly ladder: extension ladder.

Give it a dash: play a small amount of water on fire.

Greaser: engineer or pump operator.

Iron men: firemen assigned to districts where the fire hazard is high.

Jewelry: external chrome plate on fire engines.

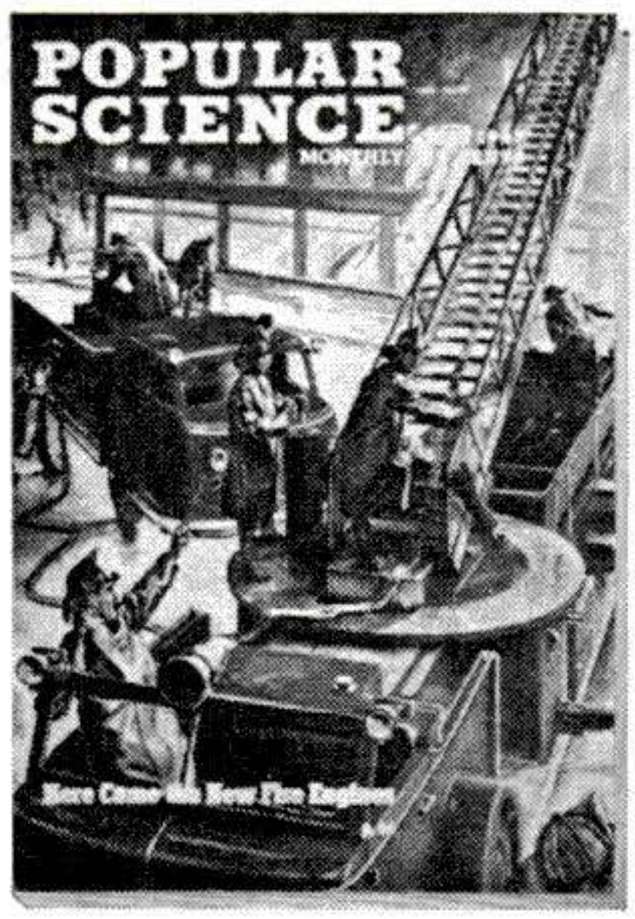
Kelly: same as a claw.

Lemon stick: a nozzle.

Loving cups: firehouse spitoons.

Milk cans: chemical extinguishers.

Nozzleman: a hose operator.



COVER: One of the new aerial trucks goes into action. Painting by Ray Pioch.

Open up: ventilate by opening up roof or walls.

Over your head and all around: put last dashes of water on dead fire.

Play pipe and stick: high-caliber streams of water.

Pomps: scaling ladders.

Pumper: an engine company.

Quad: multipurpose truck incorporating scaling ladders, a pump, hose body and water tank.

Quint: same as quad with an aerial ladder added.

Red shirts: volunteer fire fighters.

Shepherd: a hook-and-ladder man.

Shut down and take up: shut down operations and recoil hose.

Slush pump: five-gallon, hand-operated, portable water container.

Start your water: turn on water and attack fire.

Stick: brass sliding pole in firehouse.

Syringe: a water tower.

Vollies: volunteer firemen.

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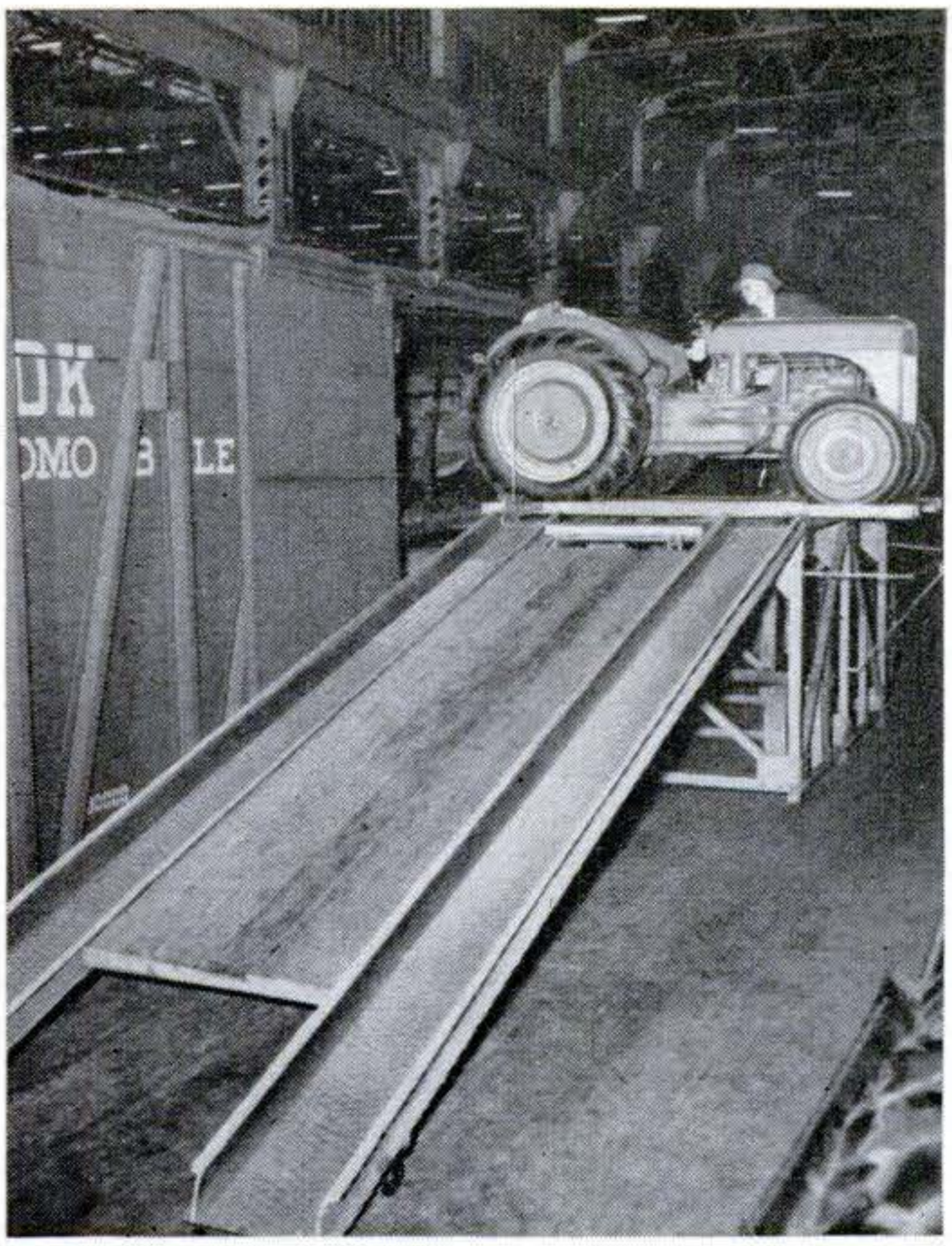
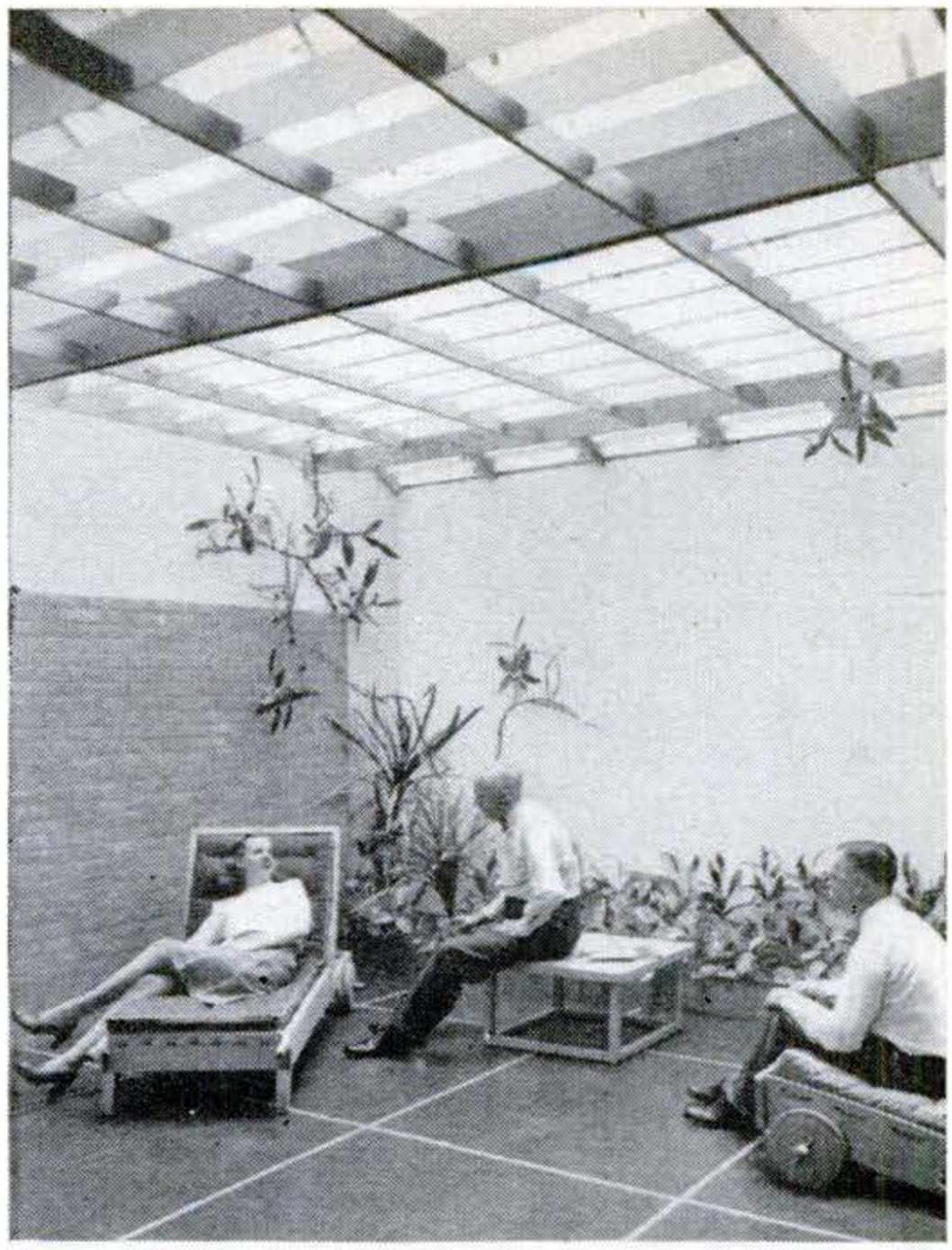
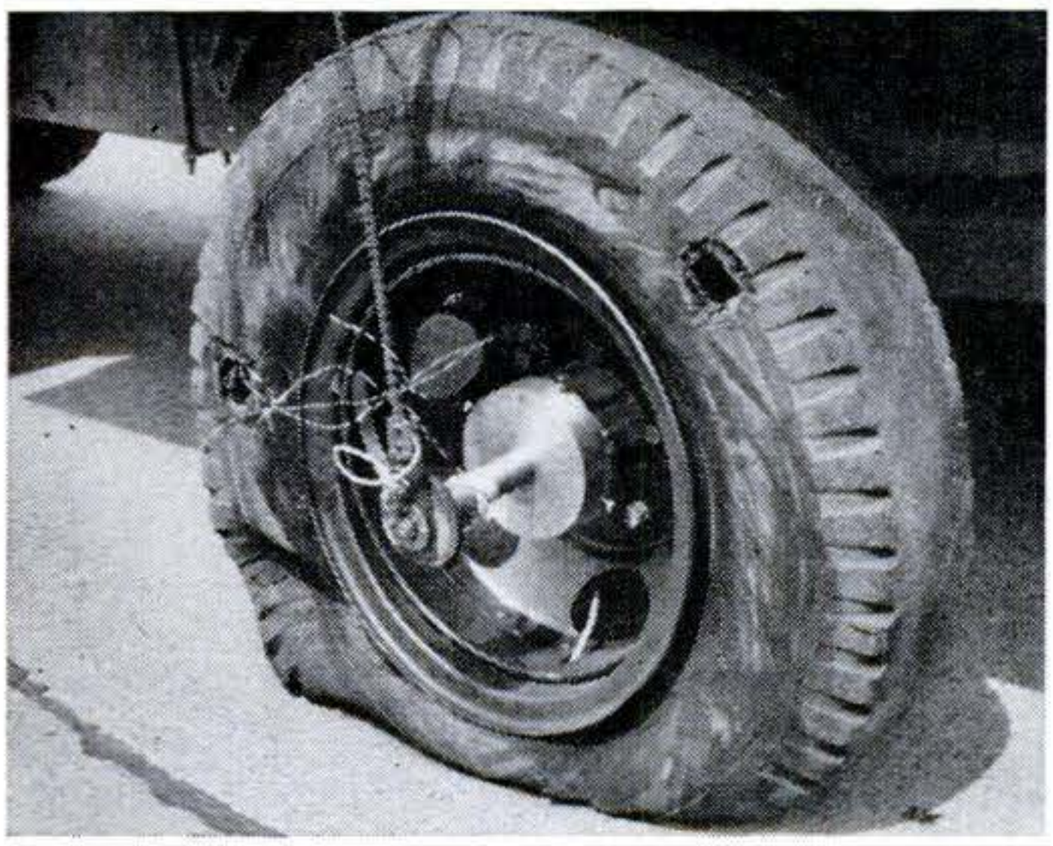


Tractor Loader. Boarding boxcars under their own power by way of a new loading ramp, tractors at Ford's Highland Park, Mich., plant no longer need the services of heavy overhead cranes. When the bottom of a two-deck car is full, tractors run up the ramp, are swung on the turntable at its top, and enter the top deck. Each car carries 14 tractors.



Electrified Sun Room. Fluorescent sun lamps, mercury lamps and reflector spotlights create an artificial sun deck in General Electric's Lighting Institute at Cleveland. The massed lights produce an average illumination of 3,000 foot-candles and heat rays of 50 watts per square foot in the 14- by 25-foot room, designed for year-'round sun baths.



Blowouts on Purpose. In testing new wheels, automobile engineers use dynamite caps to produce blowouts. Caps are put in a tire wall and covered with patches. A slip ring on the hub makes a battery connection through a switch controlled by the driver. The result is shown above.

Simpler Storm Windows. Aluminum-framed storm windows, which can be replaced in summer with aluminum screens, are easily changed from inside the house. The windows and screens are inserts that slip into permanently installed fittings. Distributed by Eagle-Picher Co., of Cincinnati.

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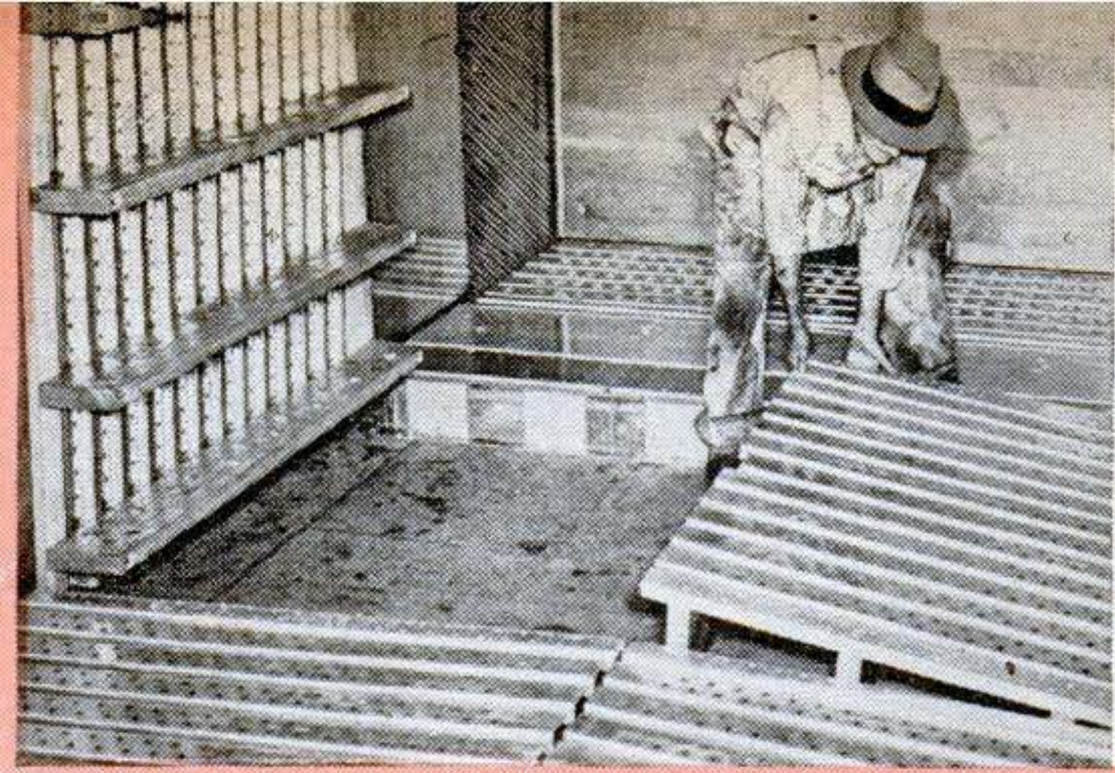
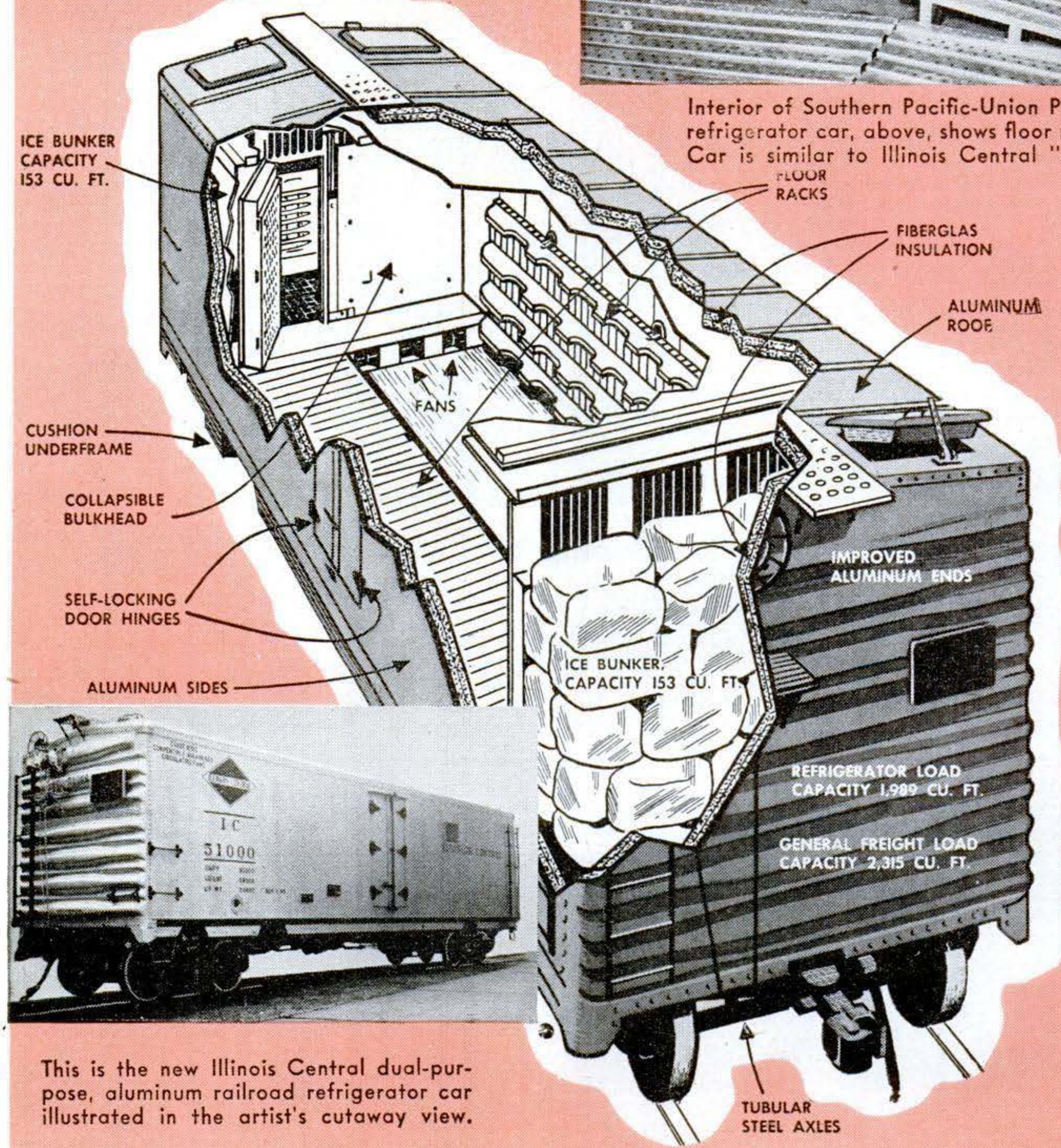
Lighter "ICER" hits the rails



Interior of Southern Pacific-Union Pacific refrigerator car, above, shows floor racks. Car is similar to Illinois Central "icer."



This is the new Illinois Central dual-purpose, aluminum railroad refrigerator car illustrated in the artist's cutaway view.

IN JUNE, 1945, the United Fresh Fruit & Vegetable Association suggested specifications for a more functional ice-cooled railway car for hauling perishables. Immediately the Illinois Central set out to build such an "icer." The Southern Pacific and the Union Pacific joined hands and did likewise. Now the roads have completed refrigerator cars, made of aluminum alloys and insulated with glass wool, that weigh about 25 percent less than the old type. They can be ice-cooled or heated according to need, and their ice-bunker bulkheads are collapsible for extra space when carrying ordinary freight. With bulkheads up, the inside area is 33 feet 2¾ inches long and eight feet three inches wide. Blower-type fans at floor level circulate air through grilled aluminum floor racks. Springs are longer, and a cushion-type underframe eases longitudinal shocks.

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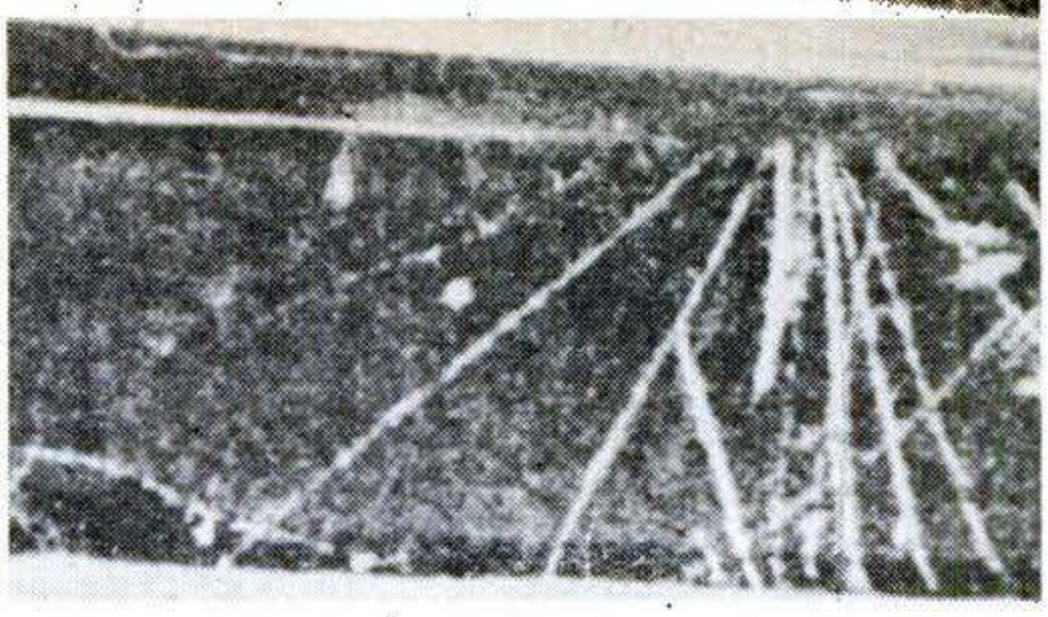
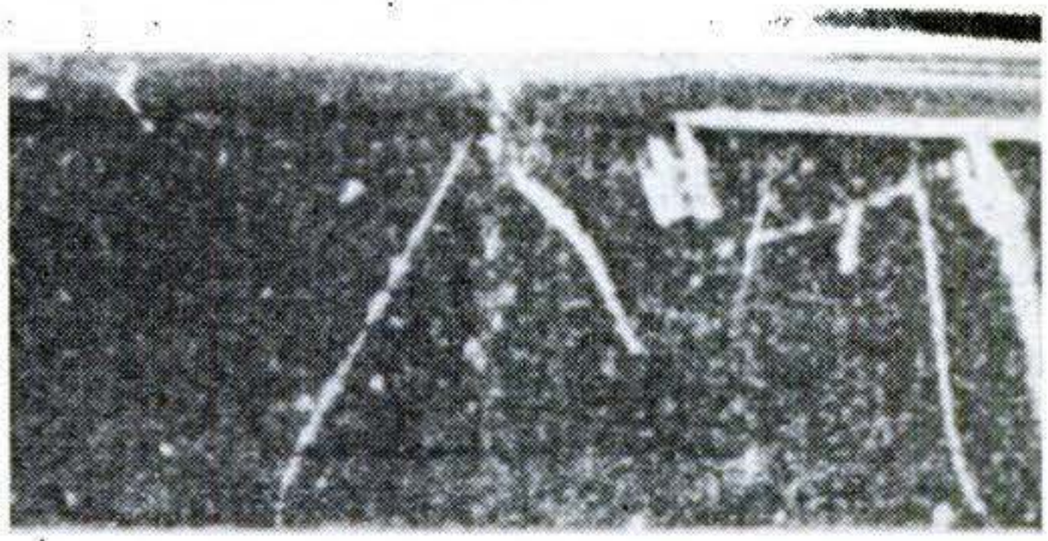
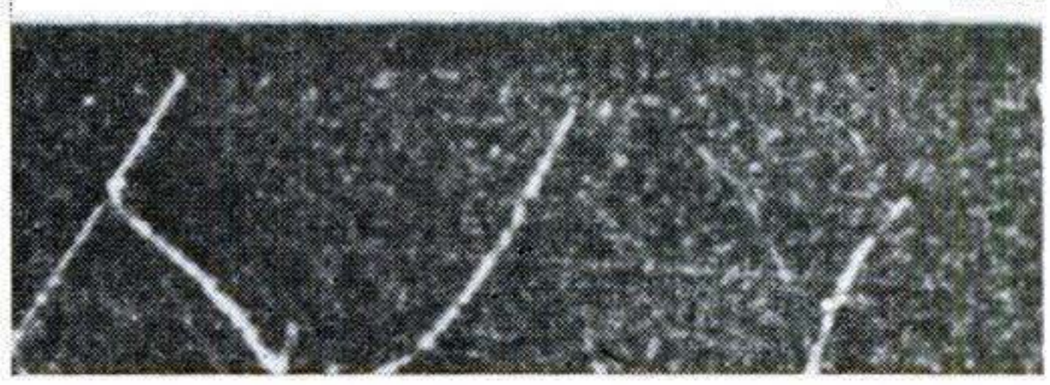
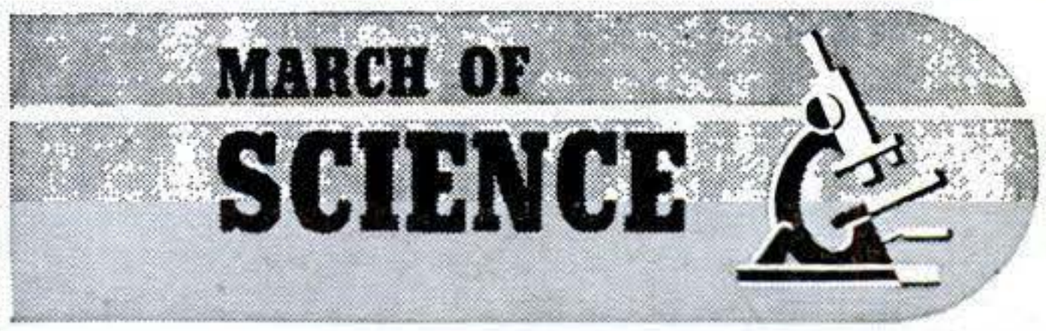
Birth of a Mesotron. At right, a mesotron, key particle of an atom, is being born. A high-energy particle from outer space has just smashed an atomic nucleus at top. The resulting mesotron left the long track starting at top center and running to the lower left-hand corner. It may possess billions of volts of energy—for a millionth of a second—and is suspected of holding the atomic nucleus together. Picture was made by Dr. W. M. Powell with a cloud-chamber camera atop 14,000-foot Mount Evans in Colorado. Lead plates, shown across photo, were placed at intervals to scatter particles and test their penetrating power.

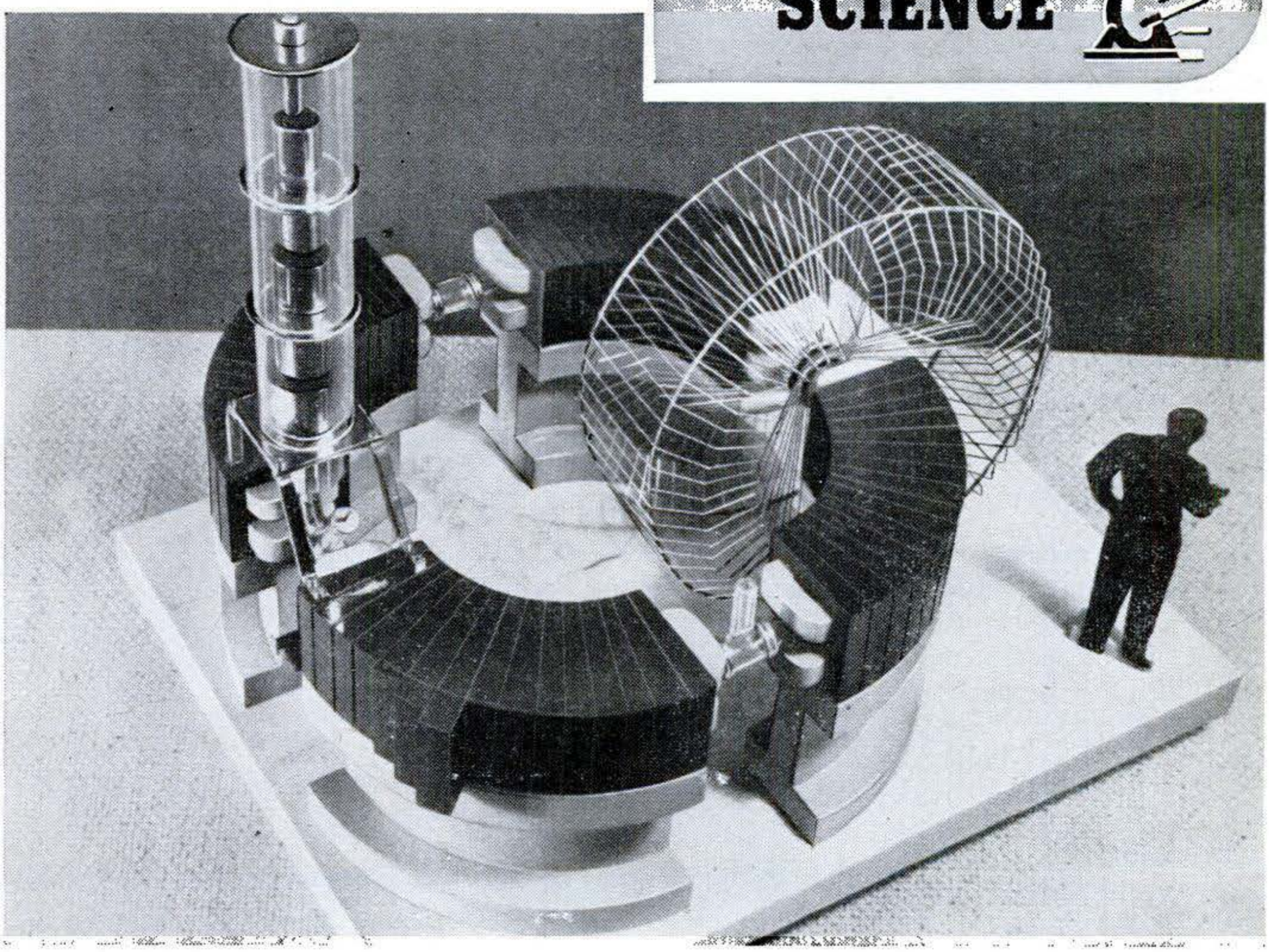






Atomic Race Track. Man may soon make his own mesotrons with a 300,000,000-electron-volt synchrotron, a model of which is shown below. Electrons will speed 2,320 miles around a race-track-shaped course in 1/80 second, close to the speed of light. After a 500,000-volt kickoff, they are guided through a vacuum by a 20-cycle-per-second mechanism enclosing the track. The resulting energy, far more intense than cosmic radiation at sea level, is expected to produce subnuclear particles. Professors H. R. Crane and D. M. Dennison are building the 15-ton machine, for the Navy.





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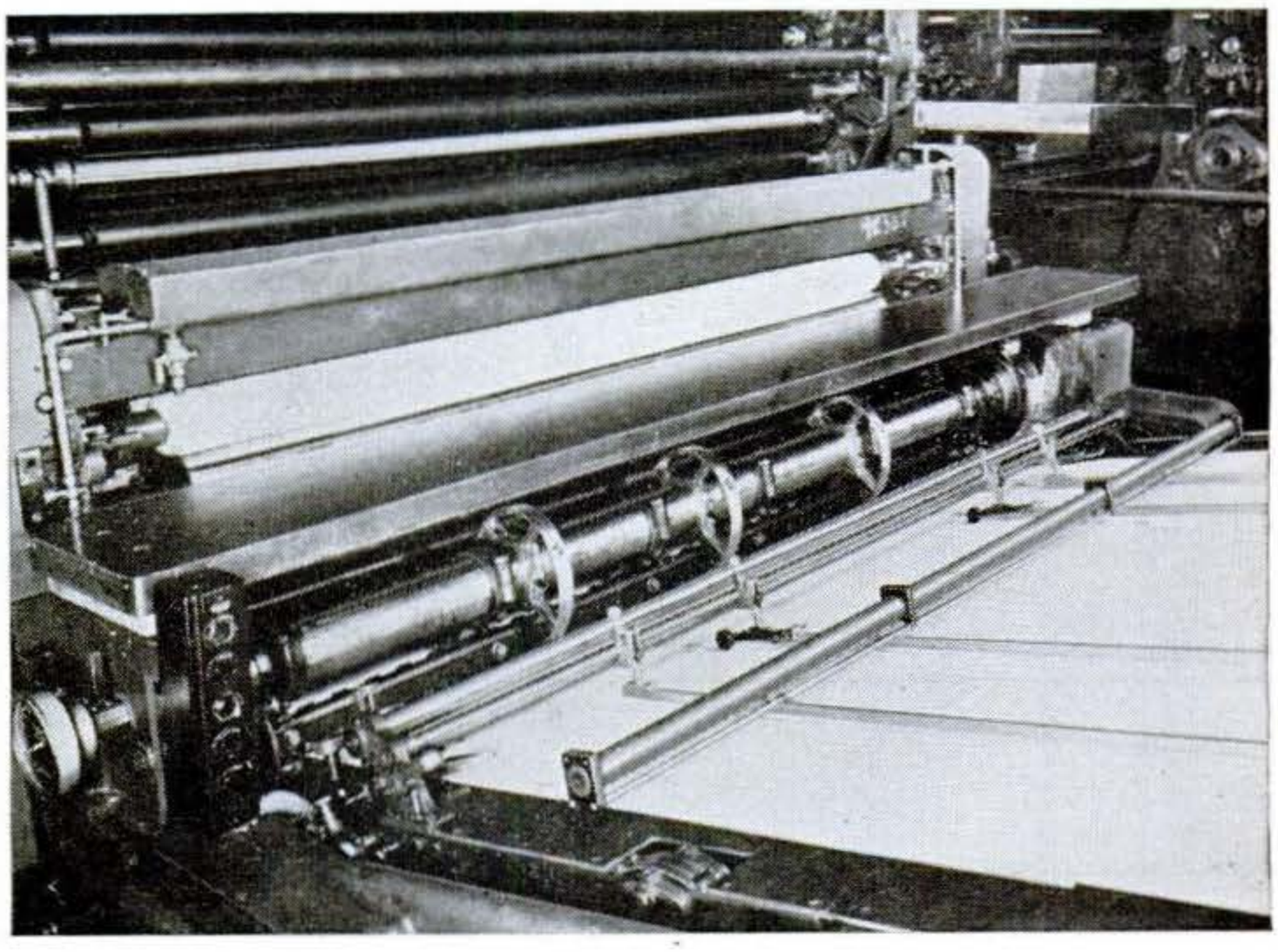
Microwave "Gun." Ultrashort radio waves are being "shot" through molecules of ammonia gas by the microwave apparatus above to give Westinghouse physicist Dr. William E. Good data on the molecules' type and structure. Ammonia moves from the left-hand bulb through the long, rectangular wave-guide "barrel" across the bottom of the photo. When the microwaves and the gas vibrate "in tune," the waves are absorbed, showing how the molecules act.

MARCH OF SCIENCE



Static Eater. Troublesome static that rumples paper, cloth, and other materials being run through machines is fully discharged by the TAKK eliminator, shown across the bed of a Miehle offset press at right. The device consists of ionizing points set on bars near static-producing parts of the machines. There are no exposed wires.

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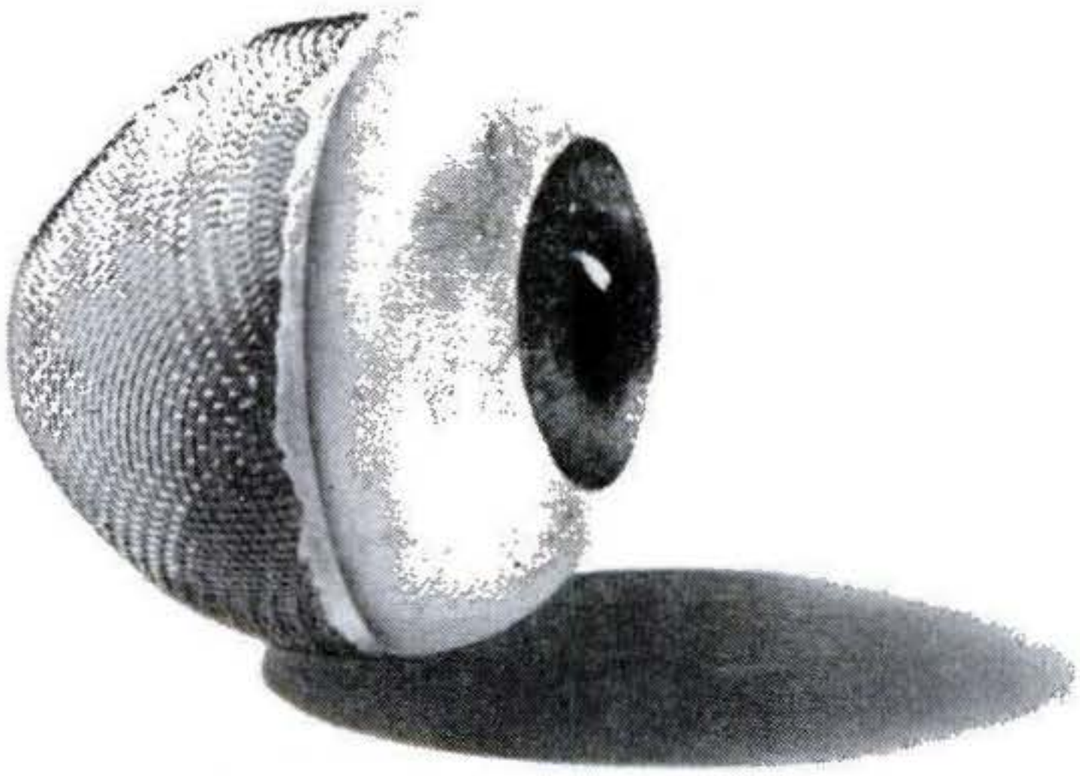
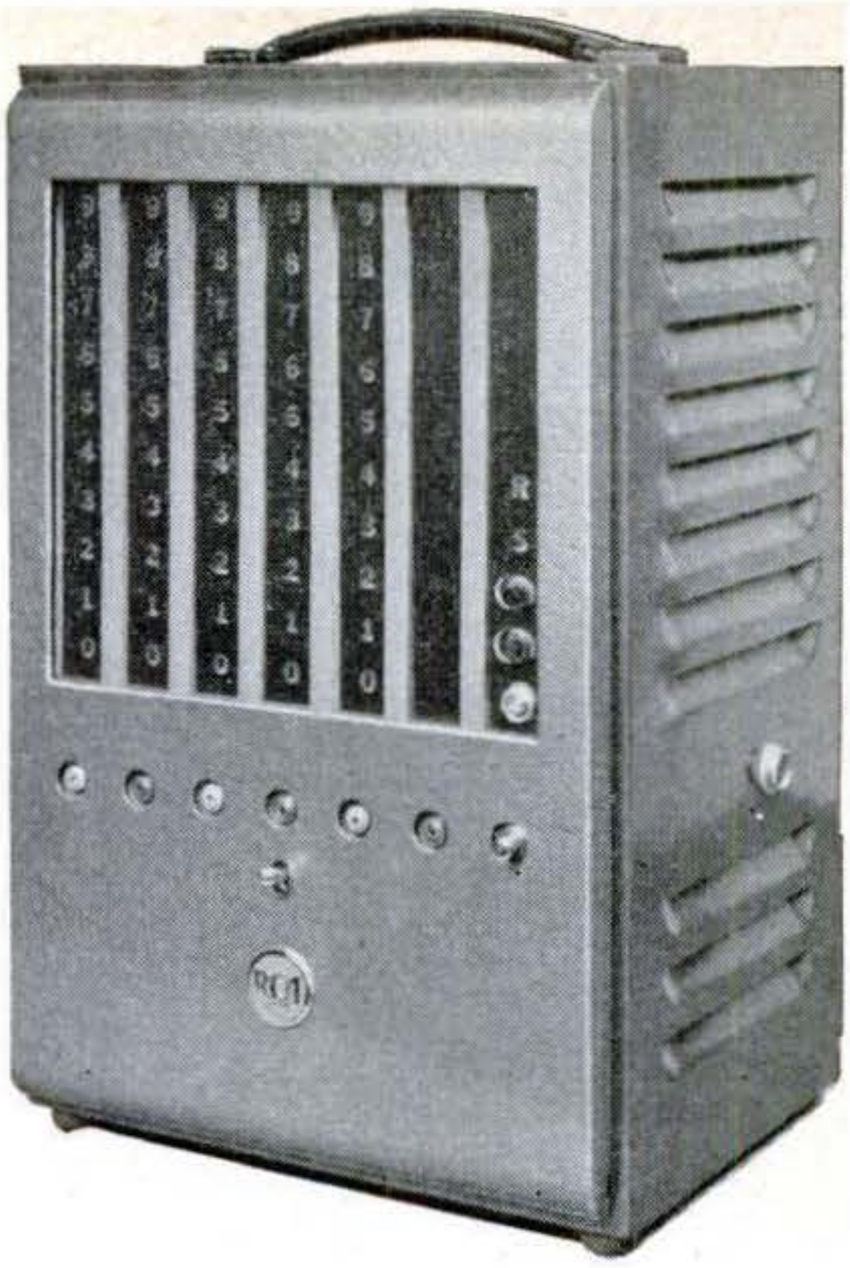
Electronic Stop Watch. Designed in wartime to clock projectiles, the electric time-interval counter, right, is now produced for industry and science by RCA. It measures speeds up to 1/1,000,000 second and counts as many as one million objects or movements per second.

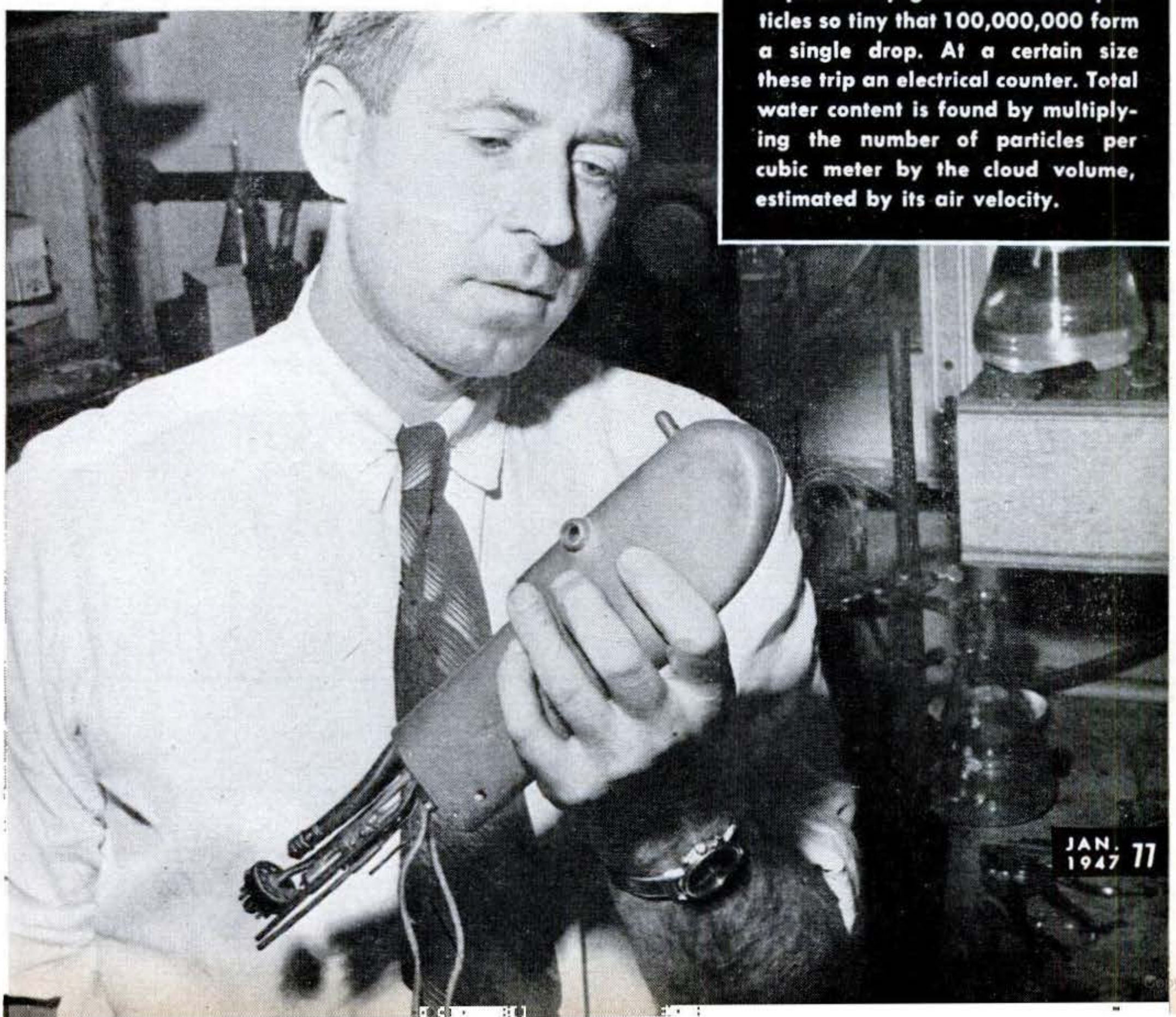




Mobile Plastic Eye. A mesh of tantalum metal on the back of the plastic eye, above, allows a surgeon to sew it to the eye muscles. Then the false eye moves in co-ordination with the real one. Dr. A. D. Ruedemann, of Cleveland, and Fritz Jardon, of the American Optical Co., developed it.

It Sizes Up Clouds.

A cloud meter that can help predict rainfall, or, on a plane, check on icing conditions, is displayed below by its designer, V. J. Schaefer, of GE. A porous cup gathers moisture particles so tiny that 100,000,000 form a single drop. At a certain size these trip an electrical counter. Total water content is found by multiplying the number of particles per cubic meter by the cloud volume, estimated by its air velocity.



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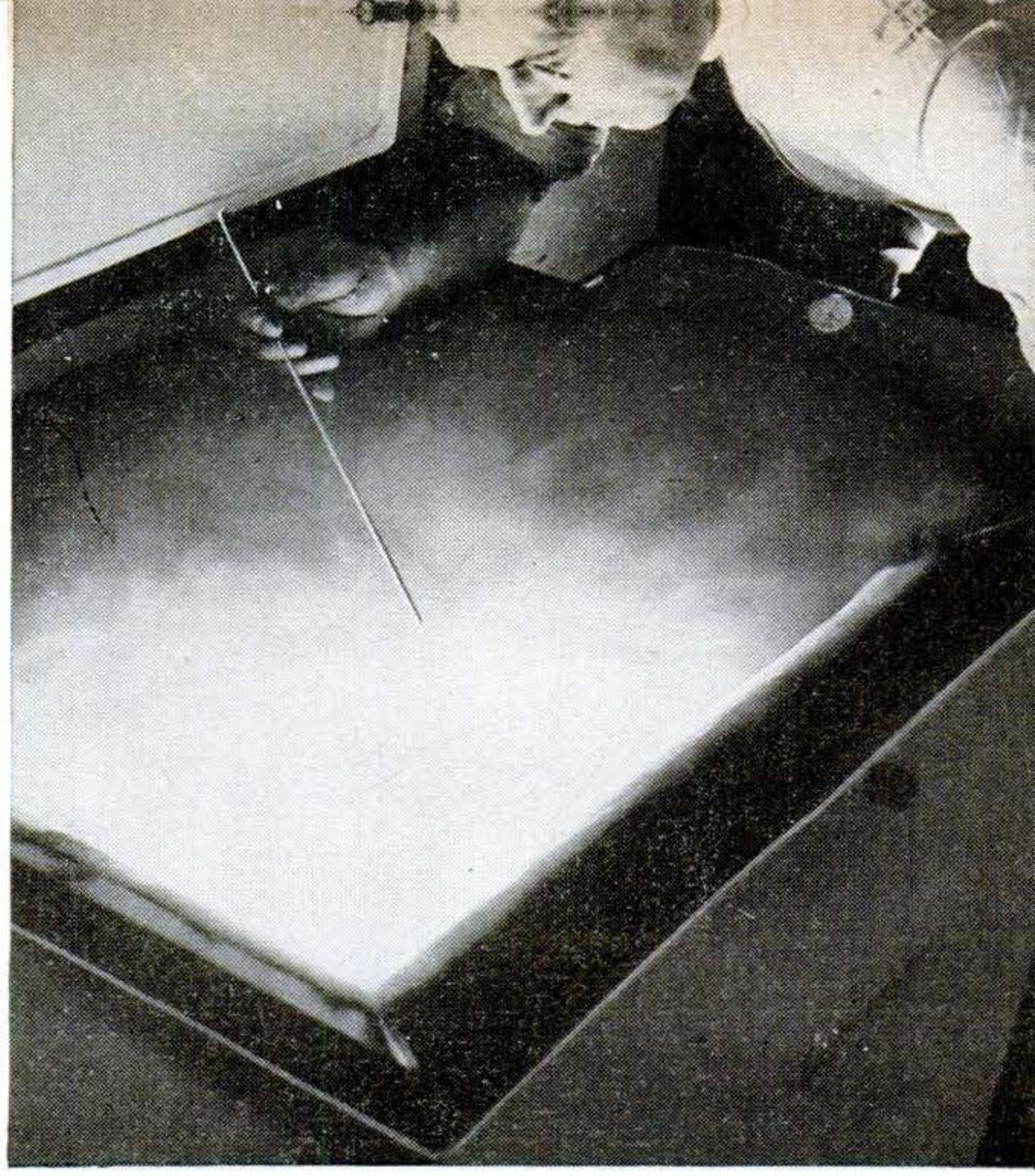
Man-Made SNOW

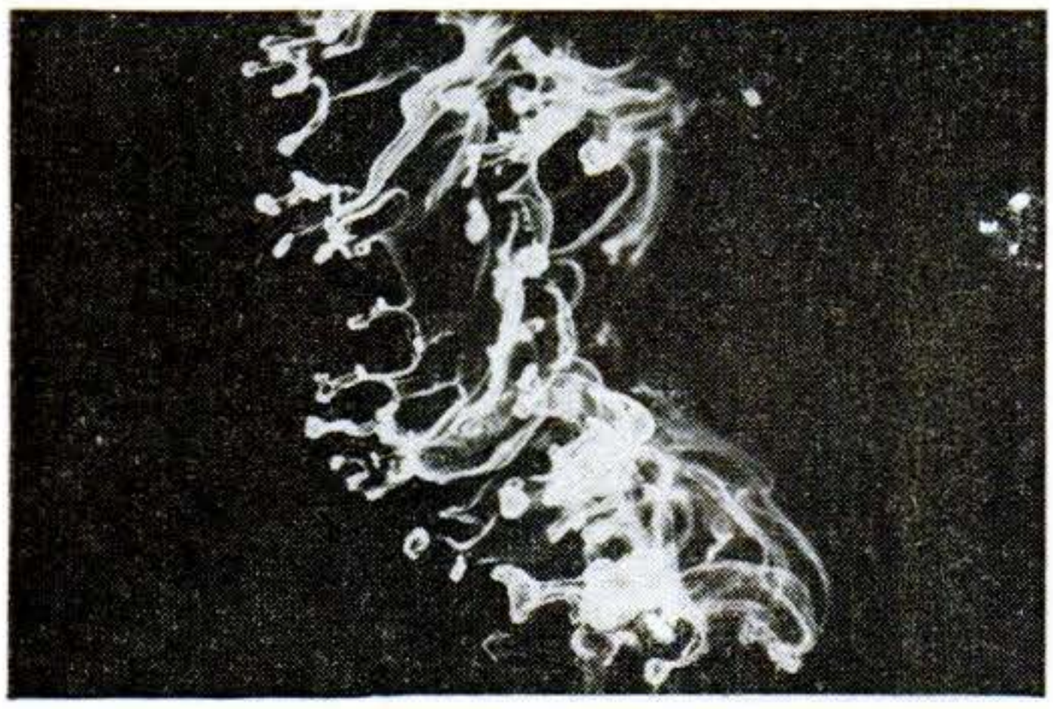
GENERAL ELECTRIC scientists flying over Greylock Mountain in Massachusetts recently seeded a cloud with dry-ice pellets and turned it into snow. Six pounds of CO_2 at −110° F. were spread over a three-mile run. In two minutes snow began to fall.

Before the outdoor test, GE had proved in its laboratory, as shown here, that man could make real snow.

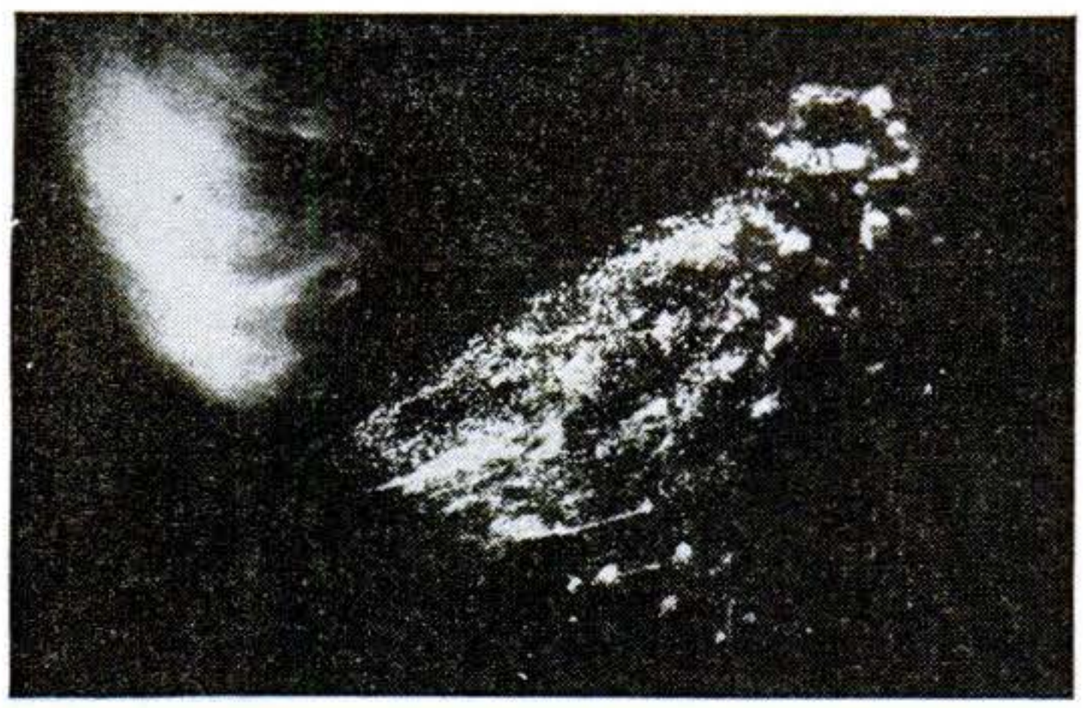
Clouds potentially full of snow are formed of minute water droplets that mysteriously remain liquid even though their temperature is far below freezing. The dry-ice pellets used at Greylock froze some of the droplets and they formed ice "germs" that attracted and froze other droplets until they grew to the size of a snowflake.



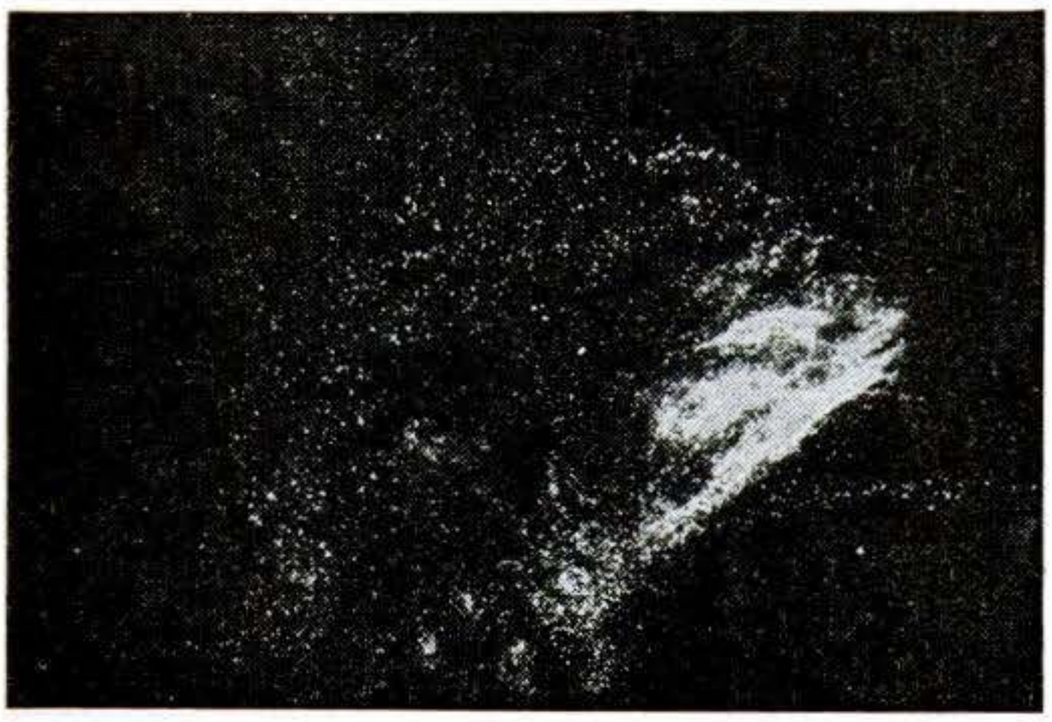
1. V. J. Schaefer, GE scientist, first man to create snow, sticks wand cooled to −70° F. into vapor cloud.



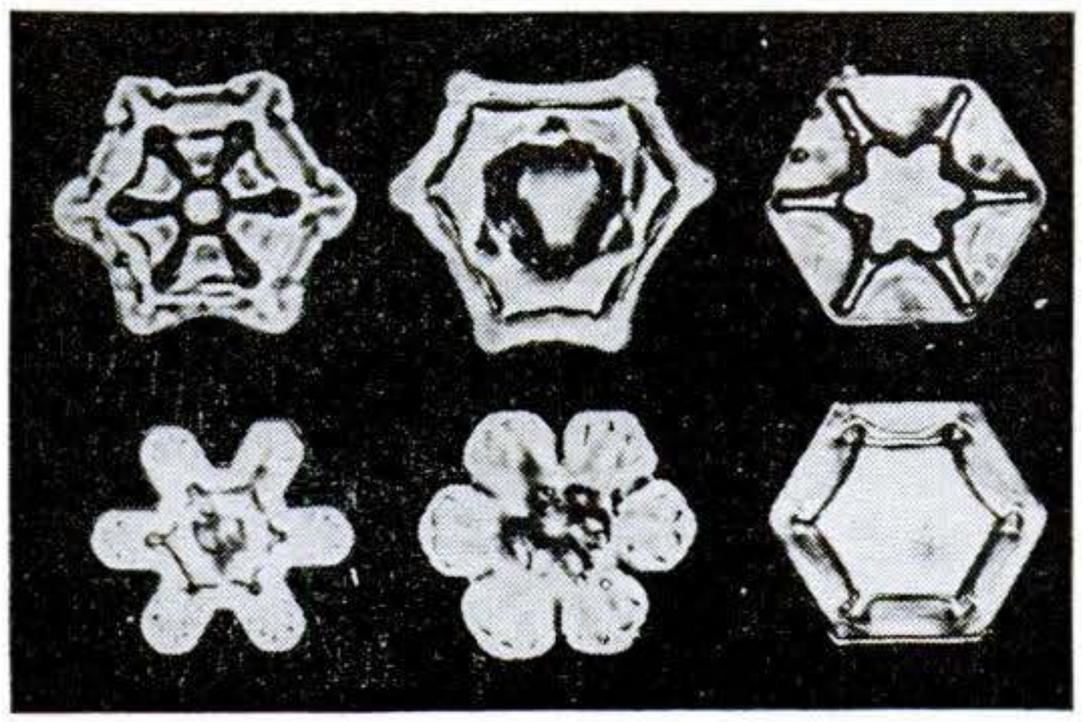
2. After a few seconds, ice germs formed by wand begin to freeze cloud's minute water drops.



3. "In-between" stage. Original cloud (upper left) has already produced some flakes of real snow.



4. Success—snow! Schaefer made cloud whence it came by breathing into chamber cooled to −5° F.



5. Photomicrographs of man-made crystals prove they're real snow, mostly "diamond-dust" type.

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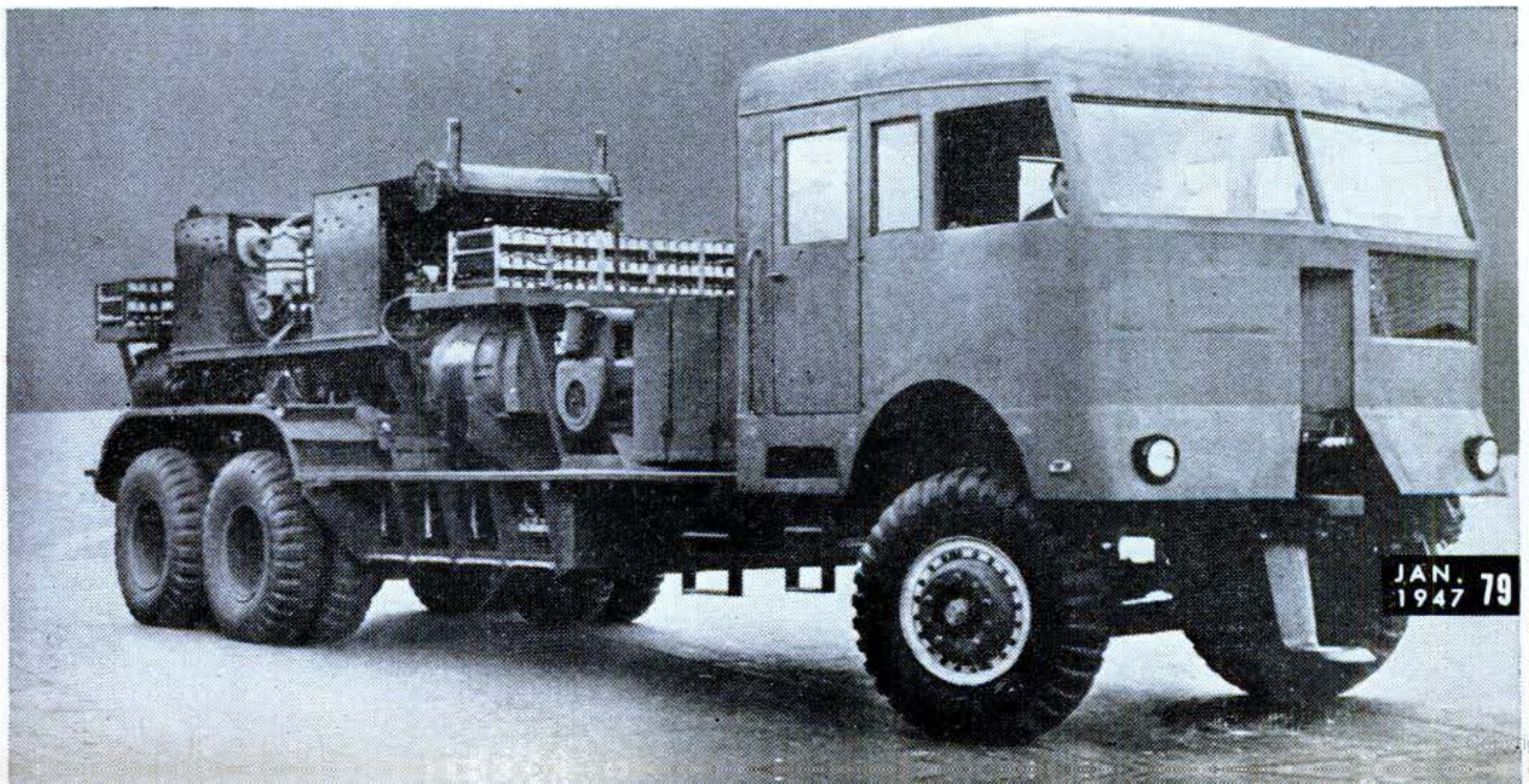
In action (right), the new rotary snowplow hurls snow and ice in a flat blanket as far as 150 feet to one side as it cuts a 14-foot swath at 25 m.p.h.

Airport Snow Remover. Built especially to clear snow from airport runways, the new dual-rotor Sno-Flyr is equipped with demountable wings for gathering in snow or slush. The wings are hydraulically controlled from the cab and can be lifted instantly for clearing landing lights and other installations. The William Bros. Boiler and Mfg. Co., of Minneapolis, powers its rugged plow with a 275-hp. gasoline engine.

Tank Tester. Heavy tanks, half-tracks and other war vehicles are trying their tractive power at Aberdeen Proving Grounds these days against the 60,000-pound drawbar pull of the 60-ton, 40-foot, 1,000-hp. dynamometer truck, below. Operated by a crew of two, the gasoline-electric giant has four traction motors, and speed, time and fuel-consumption indicators. As a dynamometer, the motors provide an electric "load" for tanks. It was built by General Electric and the Knuckey Truck Co.



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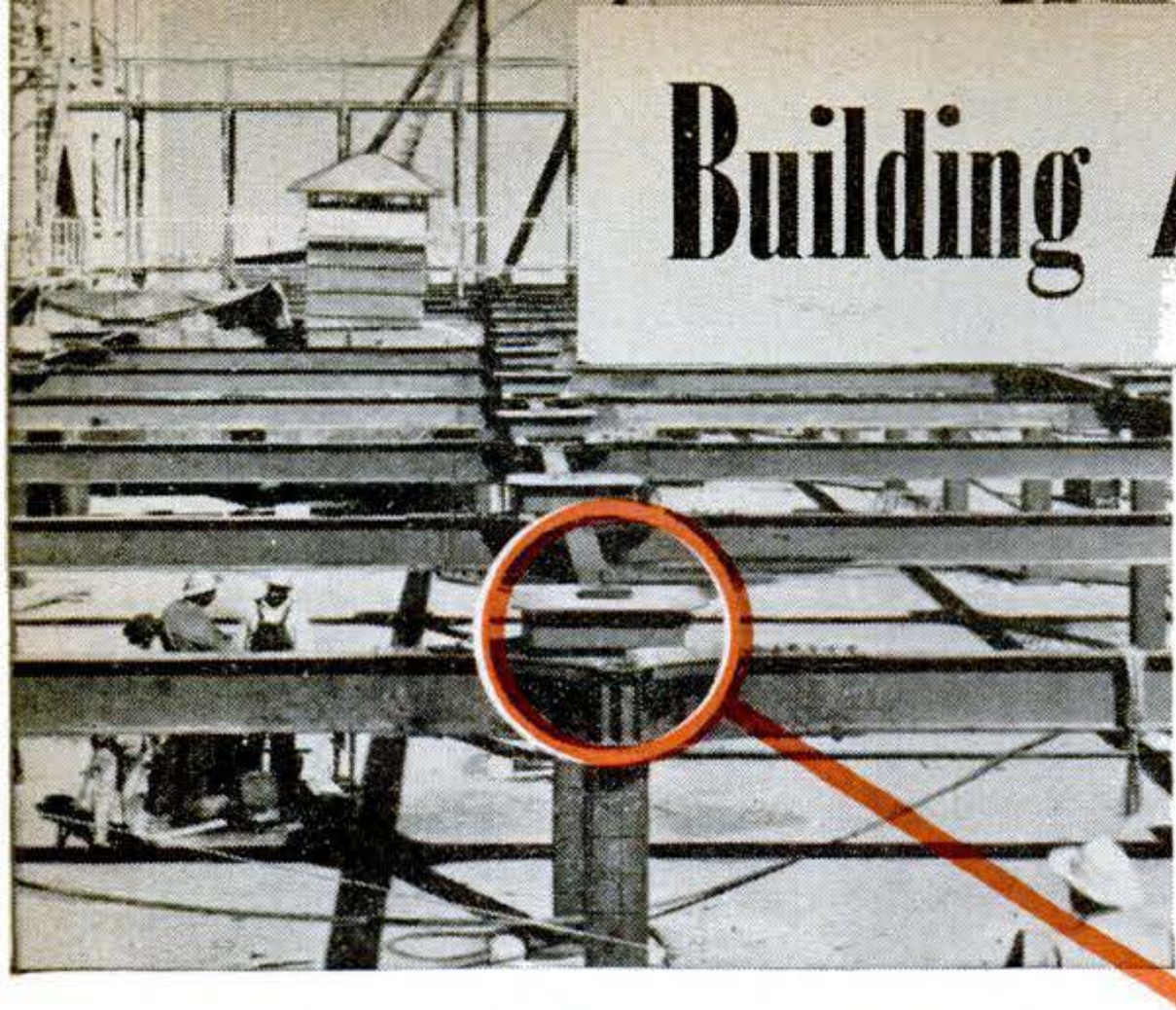
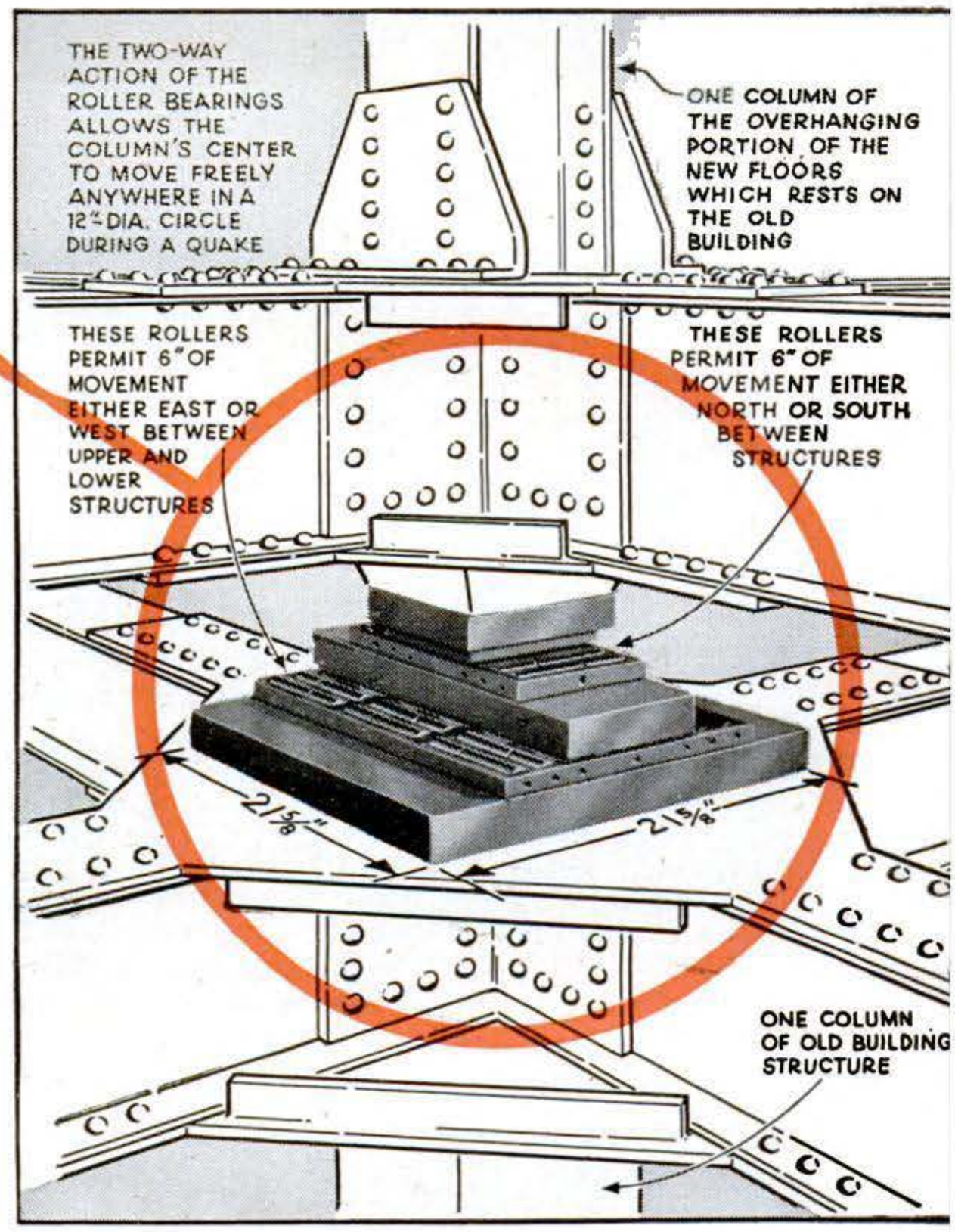
Building *rolls with the punch*



Anti-earthquake roller-bearing plate for supporting building pillar is shown at left and below. Drawing at bottom of page shows complete structure.

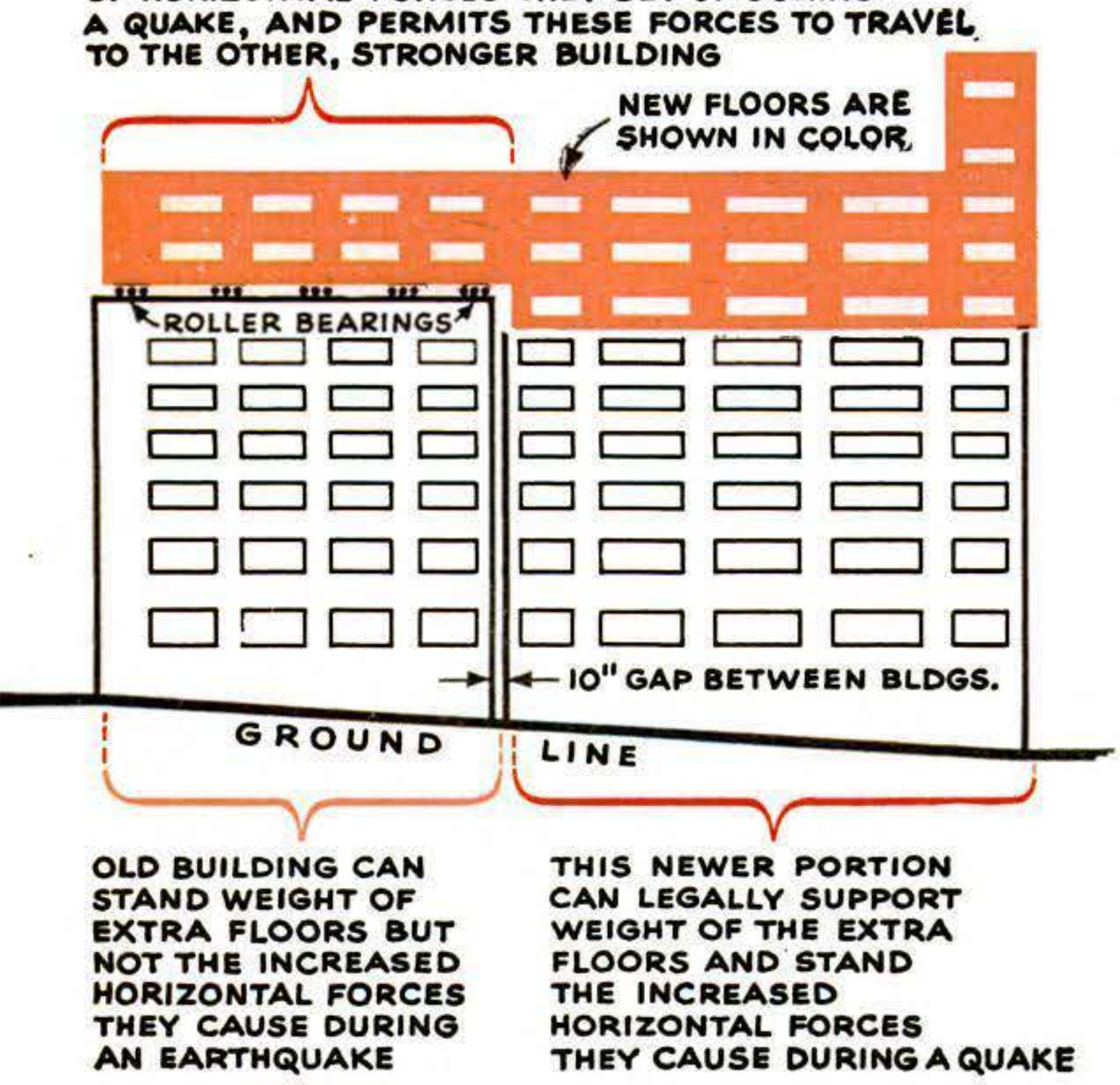


A NINE-STORY building, three stories of which can slide six inches in any direction, will soon be pointed out to visiting firemen in Los Angeles. The upper stories are being put on roller bearings to withstand earthquakes. The bearings support the entire weight of a three-story addition atop the 17-year-old, six-story Sears, Roebuck store and allow the new superstructure to ride seismic shocks.

Sixty-five sets of the bearings, weighing 600 pounds apiece and made of the hardest steel milled to 1/1,000,000 inch, have been placed under the main pillars of the superstructure. Each set is made of three steel plates with two interposed sets of rollers placed at right angles. Each set of bearings carries 250,000 pounds of building. The specially designed roller assemblies were turned out by the Torrington Co., of South Bend, Ind., to meet anti-earthquake specifications of the Los Angeles building code, a law not in effect at the time the first six floors of the Sears store were built. The old store supports the entire vertical weight of the addition, but for horizontal strength the addition is rigidly joined to an adjacent earthquakeproof building.

Each assembly of rollers is filled with a lubricant and sealed to prevent entrance of foreign matter. Tests have shown that the assemblies disclose no sign of deterioration even after 27 years. By the flotation system, the vertical loads due to gravity are separted from the horizontal stresses developed by a temblor's ground waves.

MOUNTING OVERHANG OF NEW FLOORS ON ROLLER BEARINGS RELIEVES OLD BUILDING OF HORIZONTAL FORCES THEY SET UP DURING A QUAKE, AND PERMITS THESE FORCES TO TRAVEL TO THE OTHER, STRONGER BUILDING



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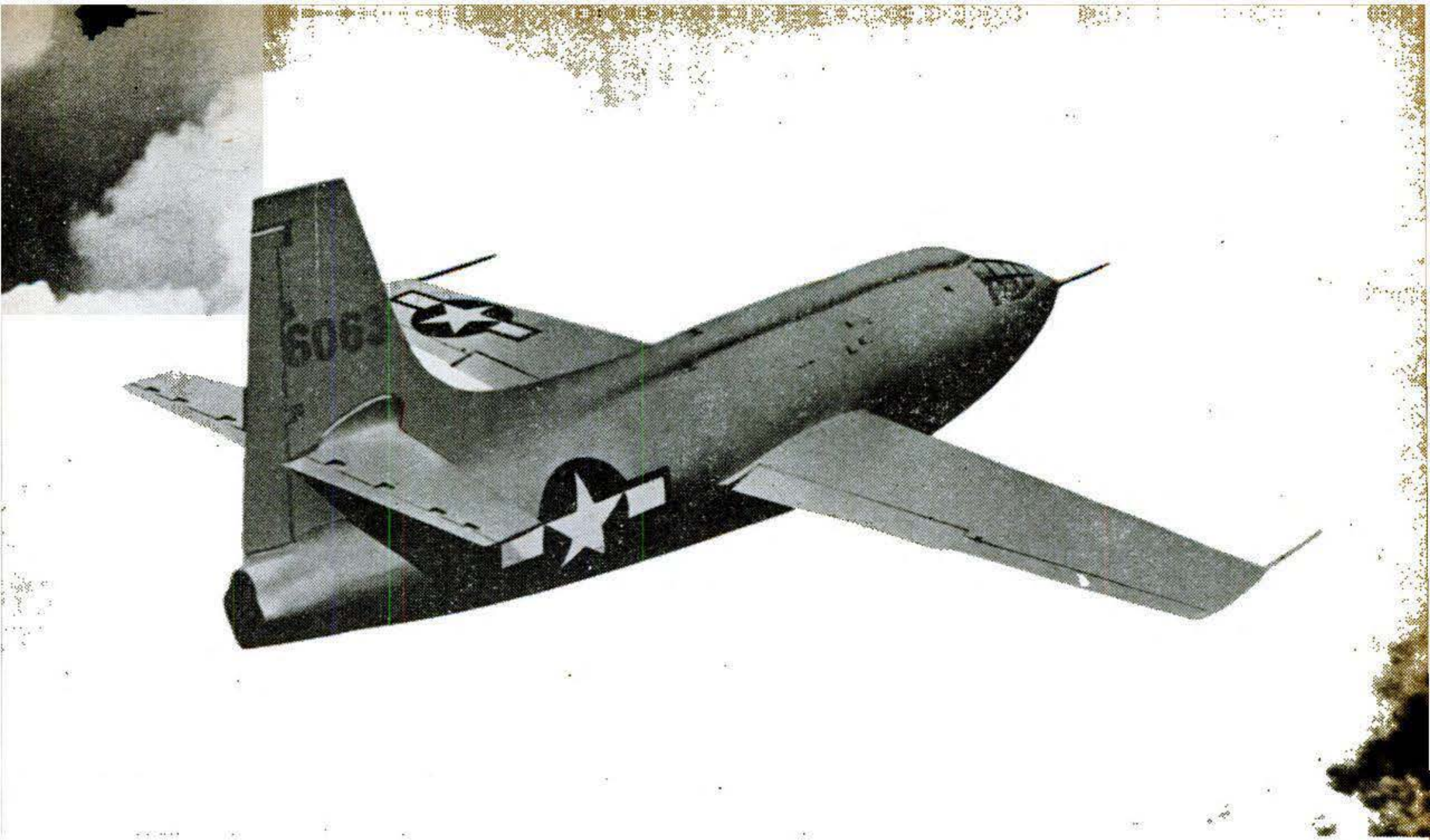

1,700 m. p. h. ?

AMERICA'S sturdiest aircraft, designed to fly eventually at 1,700 m.p.h., the Bell XS-1 is the AAF's entry in the supersonic sweepstakes. Powered by a four-unit rocket engine with 6,000-lb. thrust, it is expected to reach top speed at a record 80,000 feet.

The 31-foot plane is built to endure 18 times the pull of gravity. Unlike many supersonic wings, its 28-foot span is not swept back. Fuel constitutes two-thirds of the 6½ tons that it weighs fully loaded.

With its present power plant, the XS-1 is designed to reach 1,000 m.p.h. at 60,000 feet, but perfection of a turbo fuel pump is expected to boost the full thrust period from 2.5 to 4.2 minutes and the climb rate from 28,000 to 45,000 feet per minute. A B-29 will tow the XS-1 as high as possible, then the rocket engine will shoot it into space.

WHAT'S NEW in AVIATION

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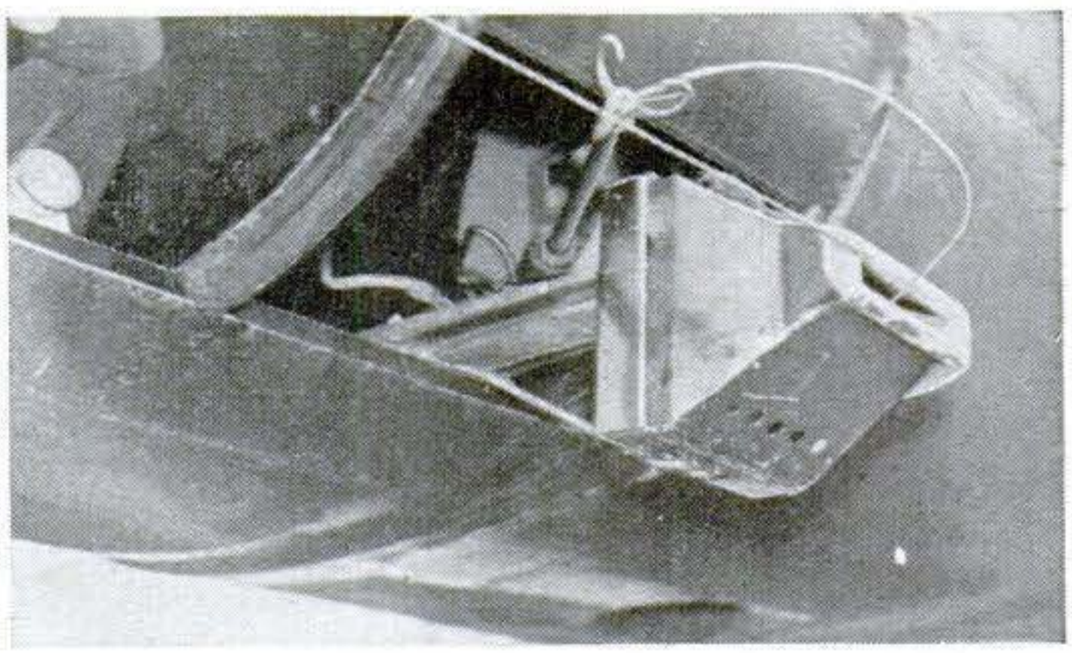
GAS STATION in the SKY

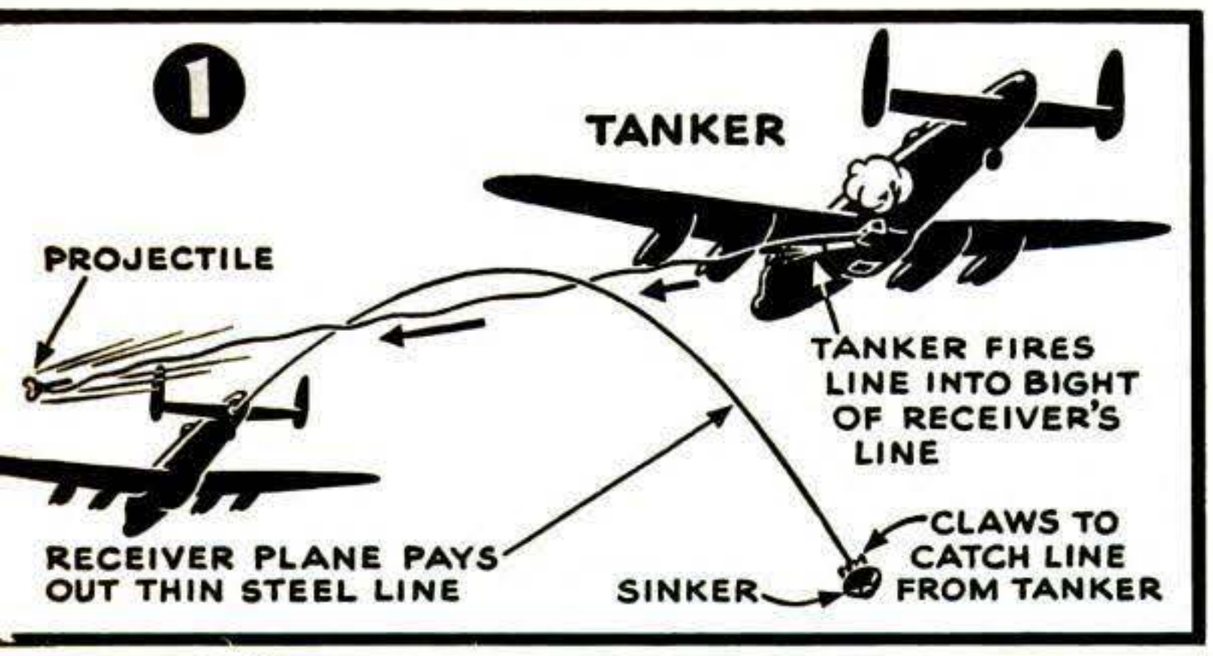
Unseen transport drags fuel hose out of tank plane above. 'Chute helps. Diagrams explain exchange.

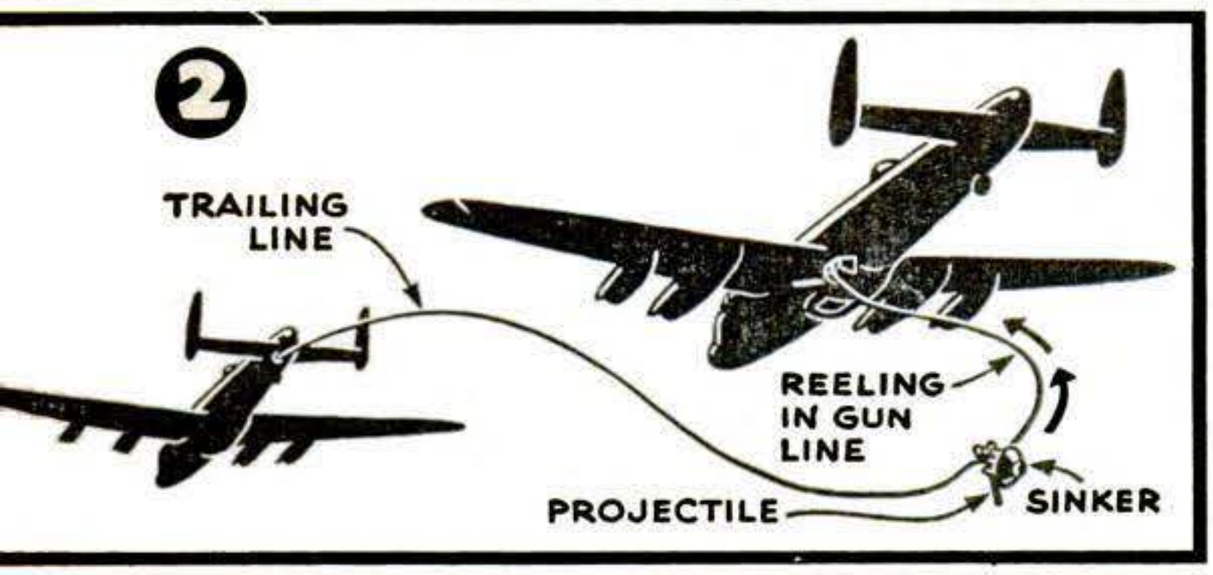
AIR LINES on both sides of the Atlantic are studying the practicality of fueling transports in the air. To make a nonstop trip between London and New York today, commercial ships have to pack heavy gasoline loads at the expense of payloads. If these liners could be serviced twice in the air while en route, payloads could be increased. Feasibility of such a service was proved recently over Cherbourg, France, when a British Lancaster bomber, with two 680-gallon tanks in its bay, transferred 1,000 gallons of gas to an air liner in 23 minutes.

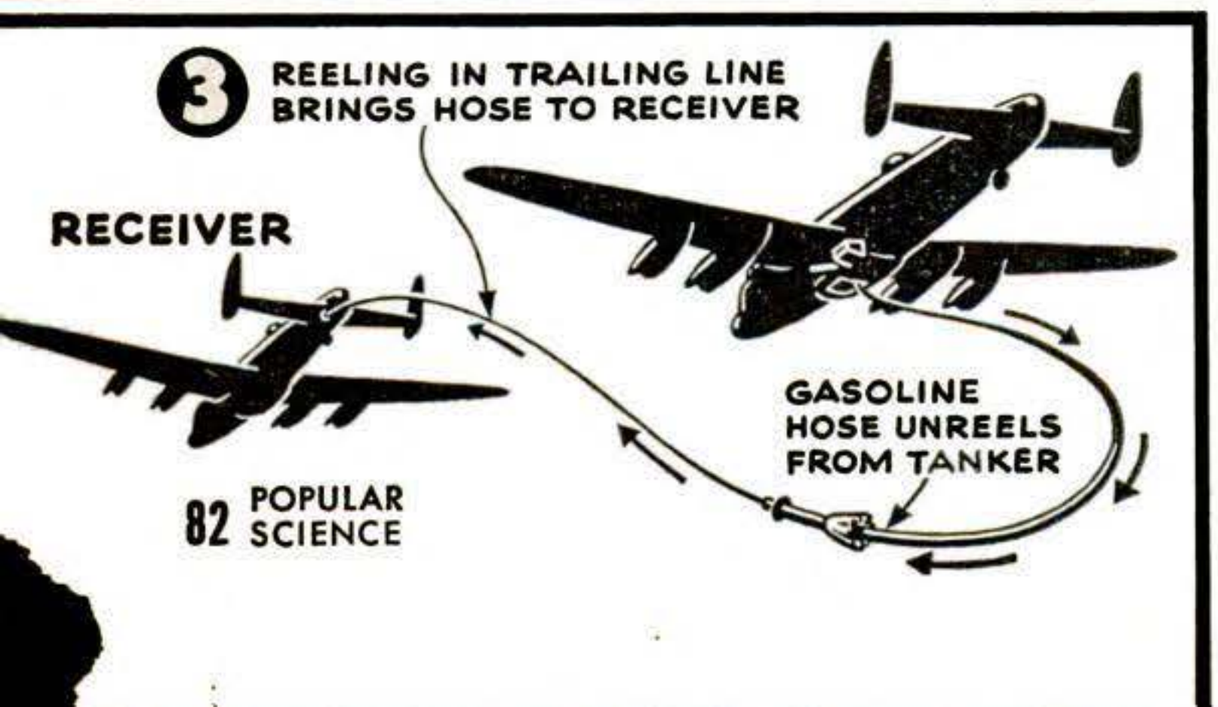
Transport's fuel intake. Out of it are played sinker, retrieving line.

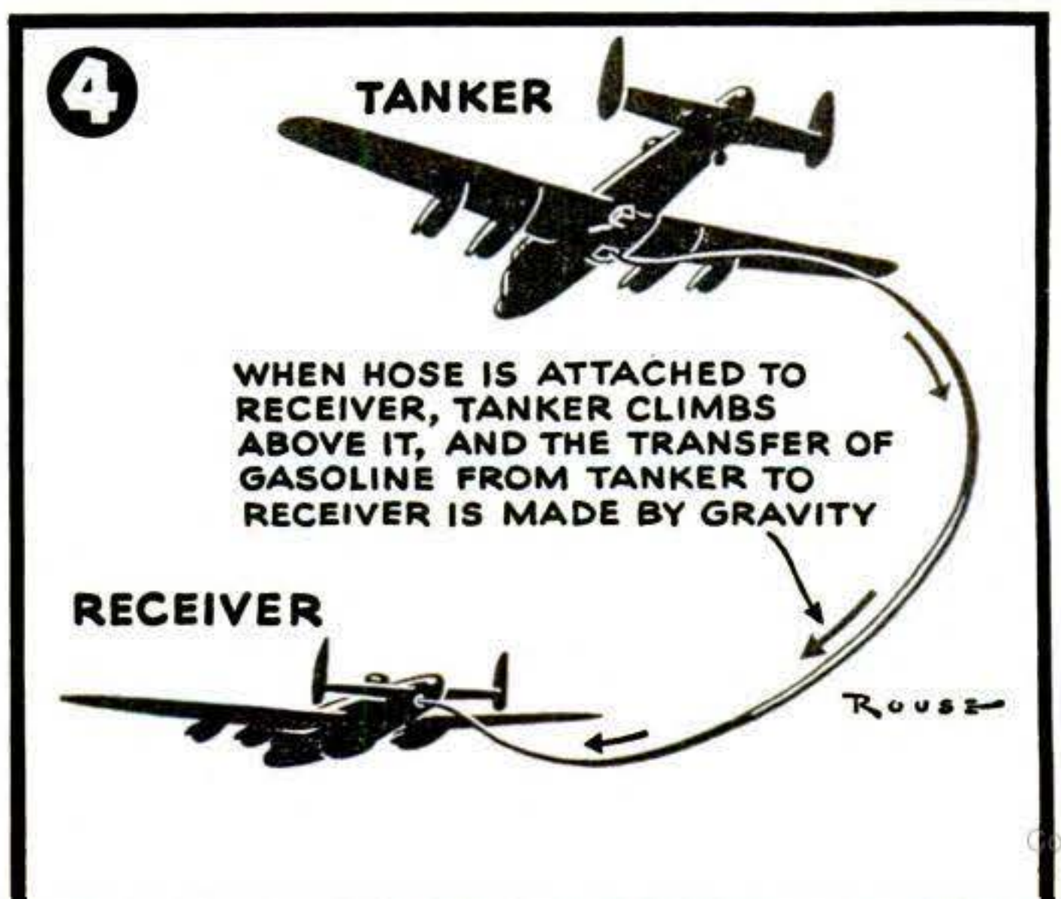


Gun and harpoon that tanker plane shoots at the transport's retrieving line. Method shown was developed by the British.









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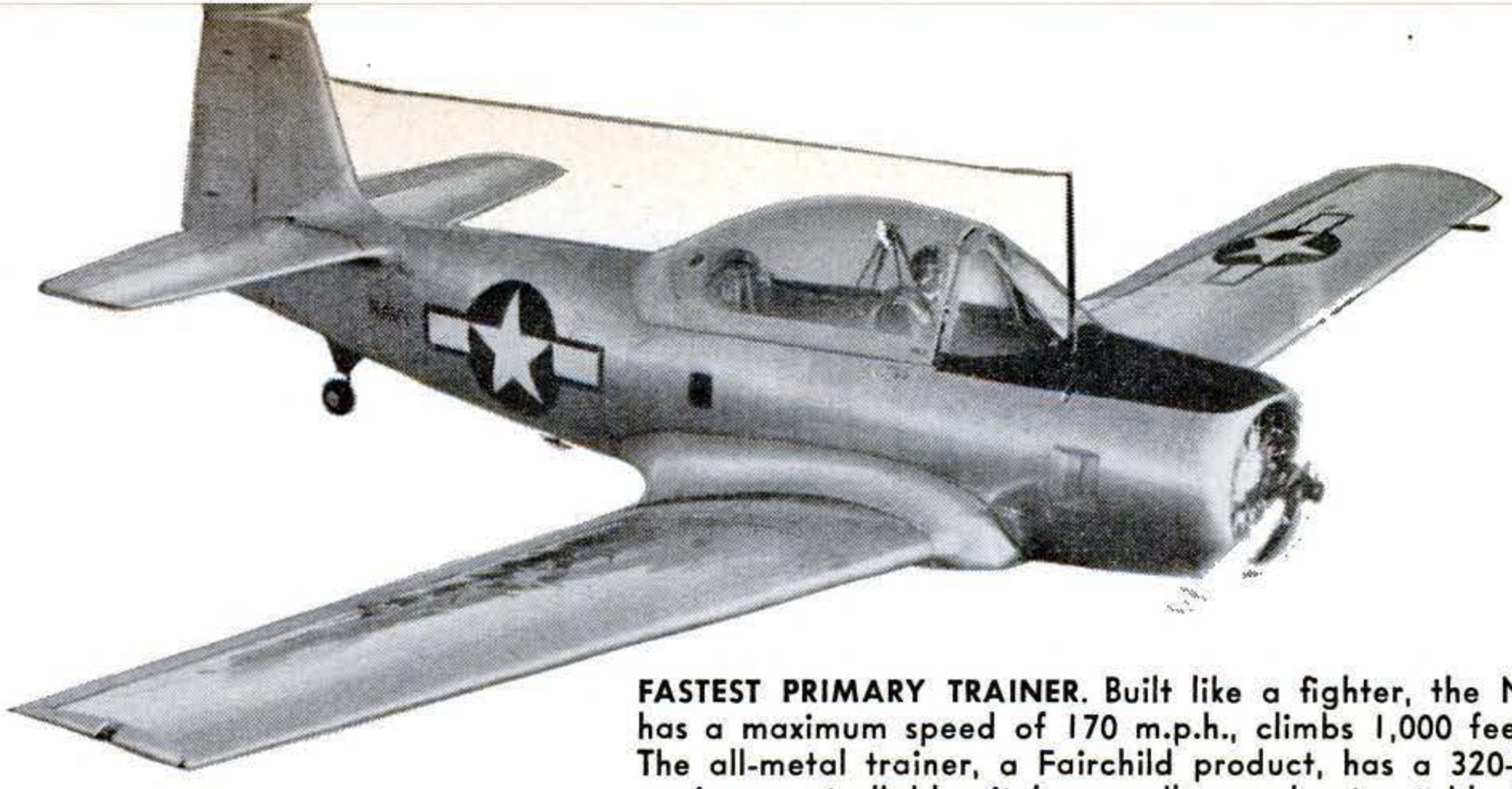
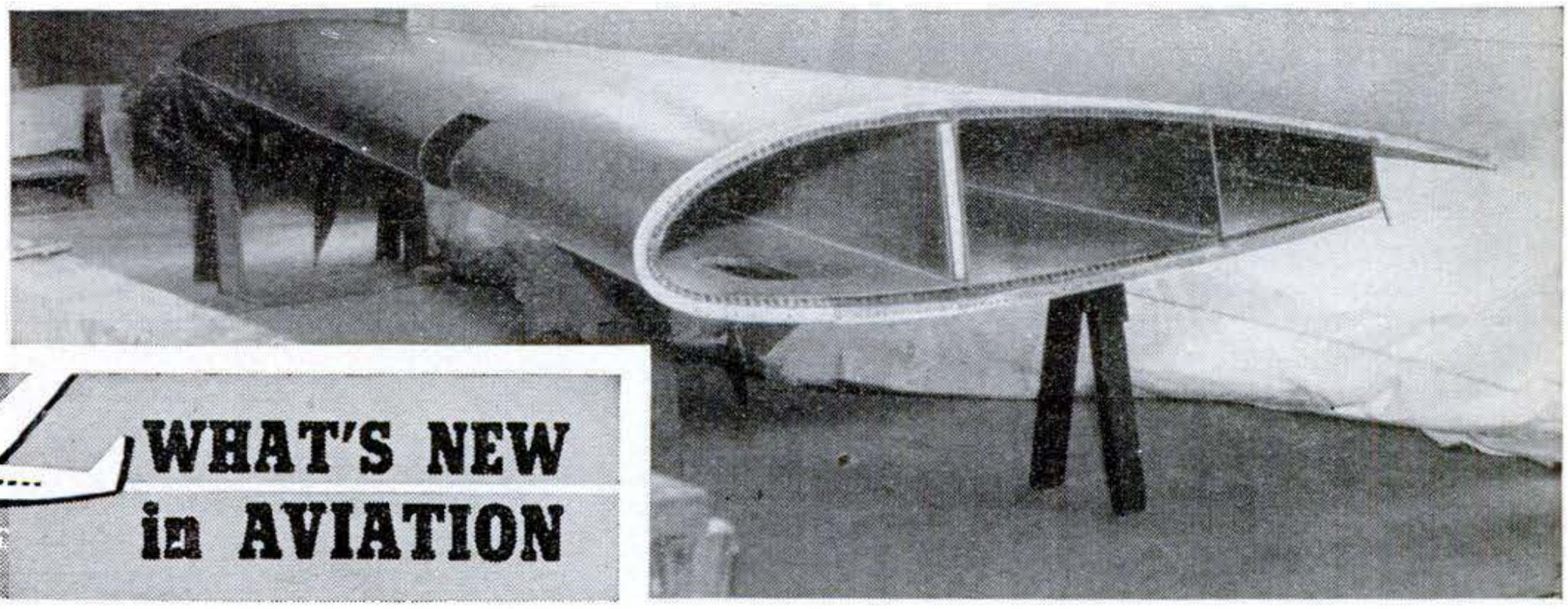


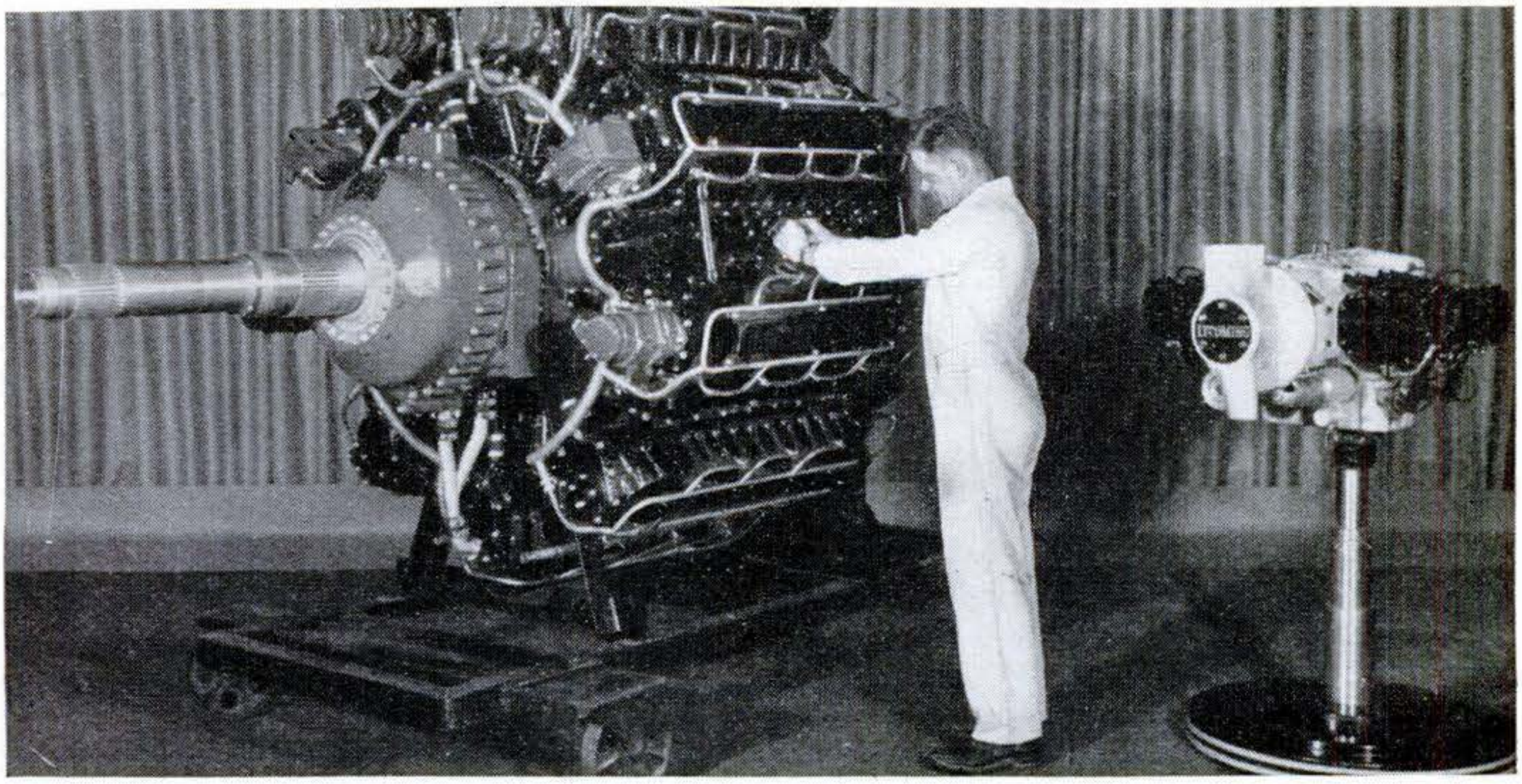
FASTEST PRIMARY TRAINER. Built like a fighter, the Navy's XNQ-1 has a maximum speed of 170 m.p.h., climbs 1,000 feet per minute. The all-metal trainer, a Fairchild product, has a 320-hp. Lycoming engine, controllable-pitch propeller, and retractable landing gear.



WHAT'S NEW in AVIATION

GLASS WING PASSES TESTS. Designed and built by Air Materiel Command for possible use in supersonic aircraft, the glass-fiber wing above withstood more than the required design load without buckling or wrinkling. The wing's sandwichlike construction makes possible an interior nearly free of bracing.

POWERFUL AS A LOCOMOTIVE. The 36-cyl., liquid-cooled, radial-type aircraft engine below is the world's largest. Built by Aviation Corp. for use in long-range AAF bombers and transports, it develops 5,000 hp. at take-off power settings. It weighs 6,050 pounds. Beside it, for scale, is a 100-hp. engine.



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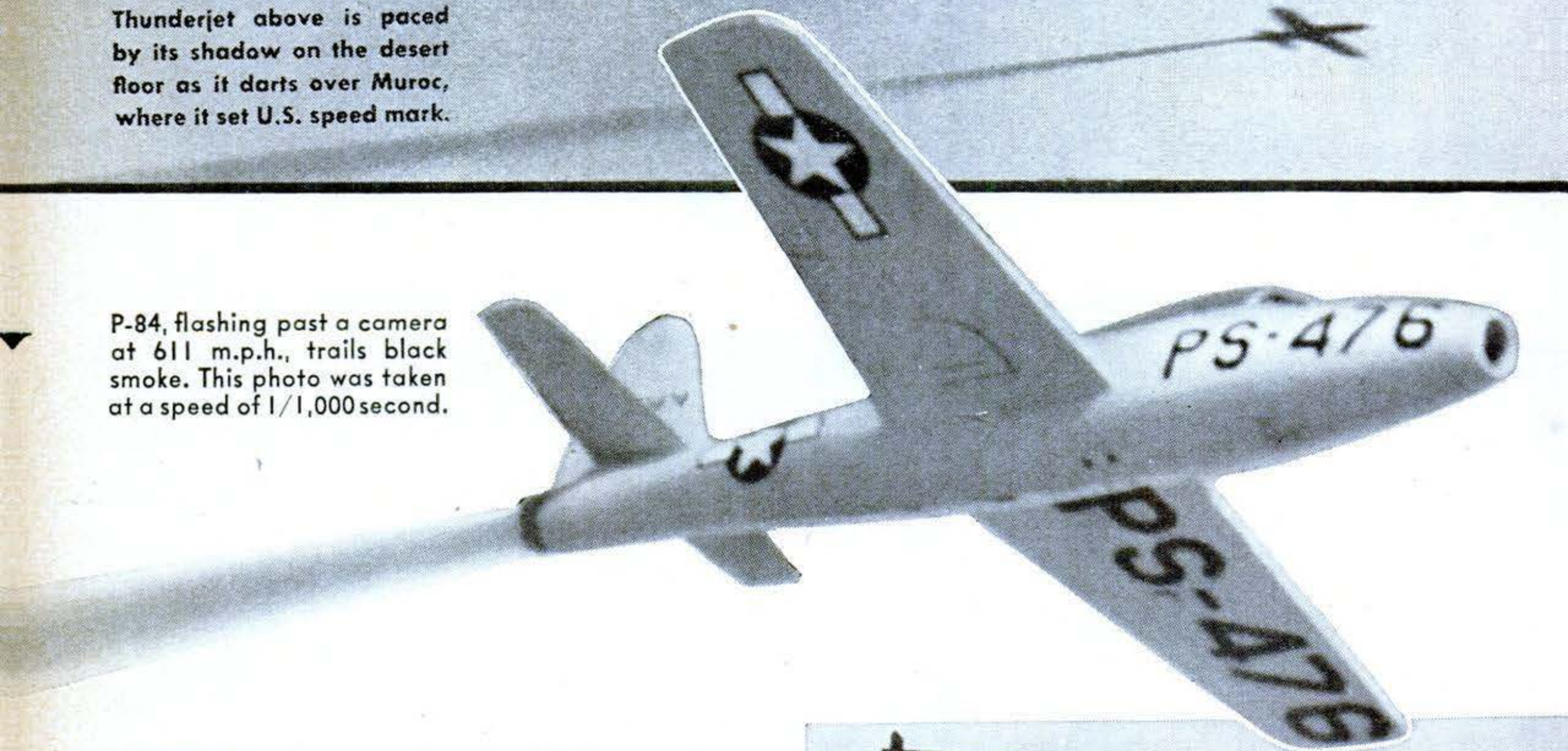
Clocking a BLACK STREAK

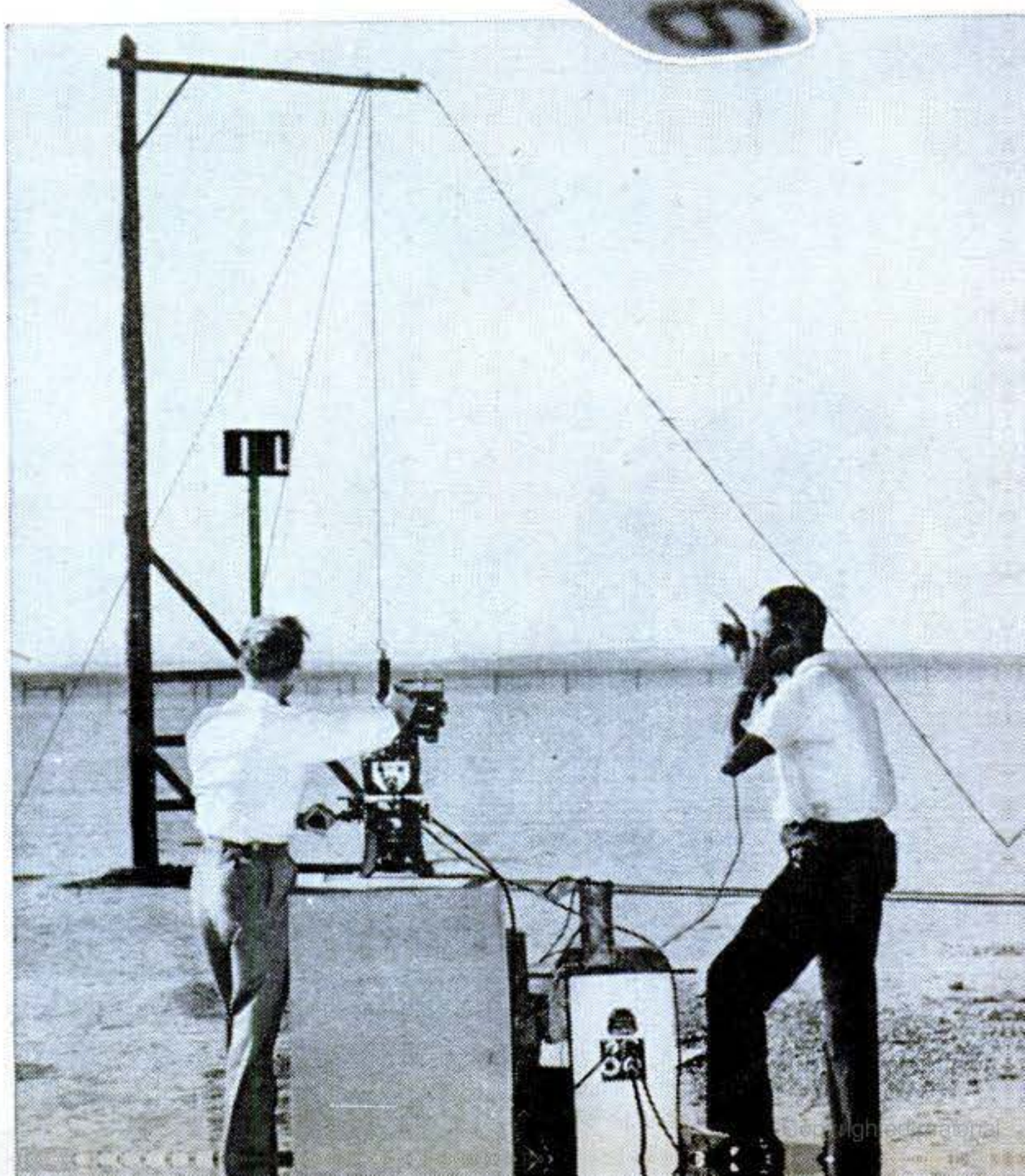
Thunderjet above is paced by its shadow on the desert floor as it darts over Muroc, where it set U.S. speed mark.



P-84, flashing past a camera at 611 m.p.h., trails black smoke. This photo was taken at a speed of 1/1,000 second.

MOVIE cameras shooting 500 pictures a second measure the near-sonic speeds of jet planes as they flash over a 1.864-mile course at Muroc Army Air Base, Calif. Fixed on concrete bases at both ends of the course, and slightly to the side, the cameras (one is shown at right) are synchronized and their speeds checked by constantly vibrating tuning forks, whose sound waves make regularly spaced marks at the edge of the film (PSM, p. 182, Aug., 45).

The course, laid out by the U. S. Coast and Geodetic Survey, is accurate to one part in 600,000. A tar strip 12 feet wide guides the pilots down the middle. Over the course, planes must fly below a 246-foot ceiling. About 12 miles out they make 25- to 35-mile turns around pylon planes, at altitudes below 1,312 feet, for return runs.



How do they know WHAT HAPPENED?

Tiny clues in strange places help crash-detectives solve air mysteries.

SHORTLY after 5 p.m. on Nov. 4, 1944, pieces of a commercial air liner began raining out of the clouds near Hanford, Calif. The transport, on a scheduled run between San Francisco and New York, was disintegrating. Startled residents of the area looked up and saw the debris come plummeting down.

The airplane had carried 21 passengers and a crew of three. None of them survived and no one else saw the airplane come apart. The plane had been seen entering the clouds in level flight. And the next thing that witnesses knew was that they saw it falling, shattered.

What had happened? The air-line business could not thrive on grim, unexplained accidents. But this wreck appeared too complete to yield an answer. Yet, just six days later, investigators had cracked the case.

Agents of the Safety Bureau's Accident Investigation Division, Civil Aeronautics Board, an independent agency of the Federal government, had combed through what remained of the aircraft. It is their job to find answers, and they nearly always do.

They slog through dozens of square miles of farm land or mountain slope, in fair weather and foul, picking up pieces. They dig for outraged engines, control cables and bits of propeller mechanism. With microscopes, chemicals and X-ray machines, they determine whether a frayed cable parted in the air or broke on violent impact with the ground. They can tell, often by a cursory glance, whether an aileron was wrenched away aloft, or at the moment the airplane struck. They cull through the ruins of big transports and small personal planes. They are on call around the clock.

These men in the Accident Investigation Division, scattered through eight regions in continental United States and Alaska, have helped reduce the air-line passenger fatality rate per mile to less than a twentieth of what it was 17 years ago; to about half, in 1946, of what it was in 1945. On their findings, design changes in airplanes large and small

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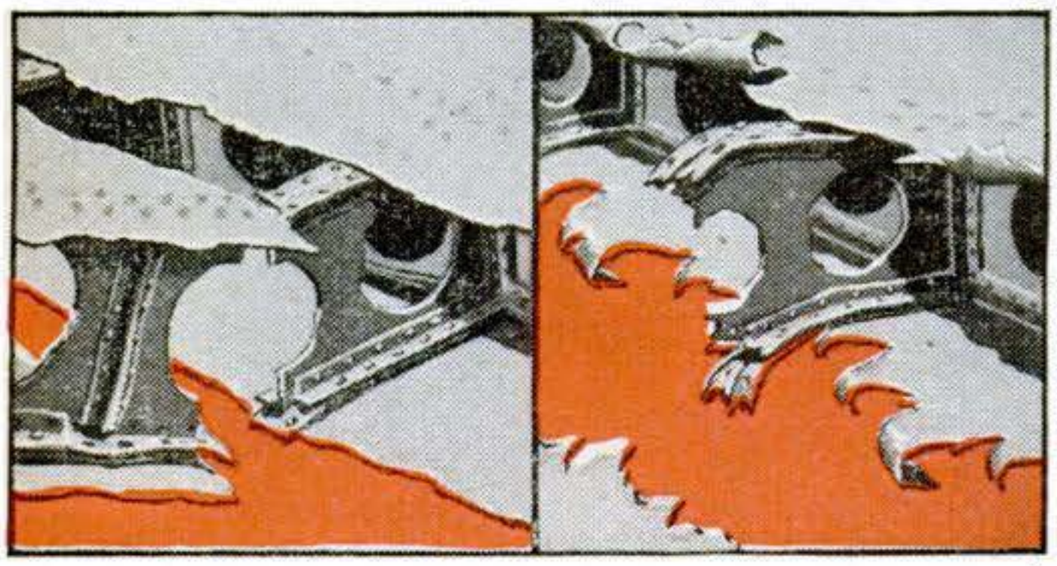
have been based. Yet there are only 24 of these air detectives.

The Hanford accident was a poser. It was commonplace for transports to fly through clouds, even storm clouds as these had been. A meticulous examination of the wreckage turned up no evidence of mechanical failure in the controls, engines, propellers, instruments or accessories. There were no signs of an explosion or fire in the air. There was no evidence of damage by lightning or hail, or of collision with any object in flight.

The team of investigators did deduce that the outboard portion of the left wing and



How wreckage broke off often tells why a plane crashed. Comparatively clean fracture at left resulted from shearing, caused by overstress during flight. Irregular, jagged break at right was caused by impact of the plane hitting the ground.

the horizontal tail surfaces had failed. An examination showed that the wing panel had sheared off from strain, not from impact. It had swung back and shattered the cabin.

But what had caused it? It looked as though this crash would have to be chalked up to "causes unknown."

Then one member of the team, raking through the remains, found the "flight analyzer" the airplane had carried. The analyzer was nothing more than a barograph with a clockwork mechanism that recorded altitudes flown by the plane and the times it flew them.

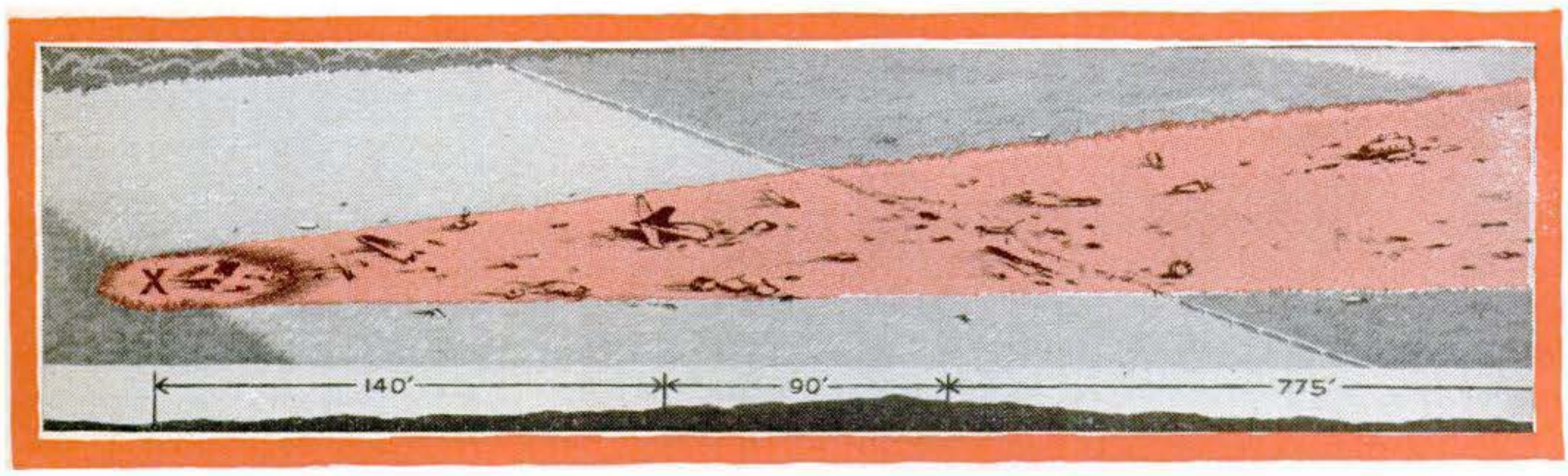
This held the answer. At the time of the accident the stylus of the instrument had reversed its path of travel on the time-line. *That could have happened only if it was upside down.* Therefore, the airplane also had been upside down, capsized by rough air. It was not built to stand the stresses of inverted flight in the turbulence of a thunderstorm. It had come apart.

Relatively, that case was easy. The Division tackled one of its major mysteries last July at Reading, Pa., when a new type of four-engine transport caught fire in the air on a training flight and crashed. Every member of the crew was killed save one, who supplied the investigators with meager information.

It was vital to know what had happened; the new transports were being sold in volume to the air lines. The investigators gathered while the wreckage was still smoldering. Smoke had billowed into the cockpit before the crash. That much was established. But what had been its source? Why had an inferno developed? The witnesses did not know.

Then someone had an idea. The air line involved was asked to fly an identical aircraft to Reading as a guinea pig. The investigators combed through the duplicate plane. In the forward baggage compartment, they found several studs—brass bolts connecting electrical cables in the wings to others inside the fuselage—that bore evidence of intense heating. Inflammable hydraulic fluid was near by.

Then the investigators returned to the wreckage. They dug. They scraped. And presently they turned up the answer—studs that bore bad pits from electric current burns, distinct from burns by flame. Current in the cables obviously had arced over the studs, which were loose in their fittings. The arcing had occurred against the inside



The wreckage pattern is important evidence. Distance pieces are thrown ahead of impact point shows speed at which plane hit. Any part found far *behind* impact point obviously came off in air.

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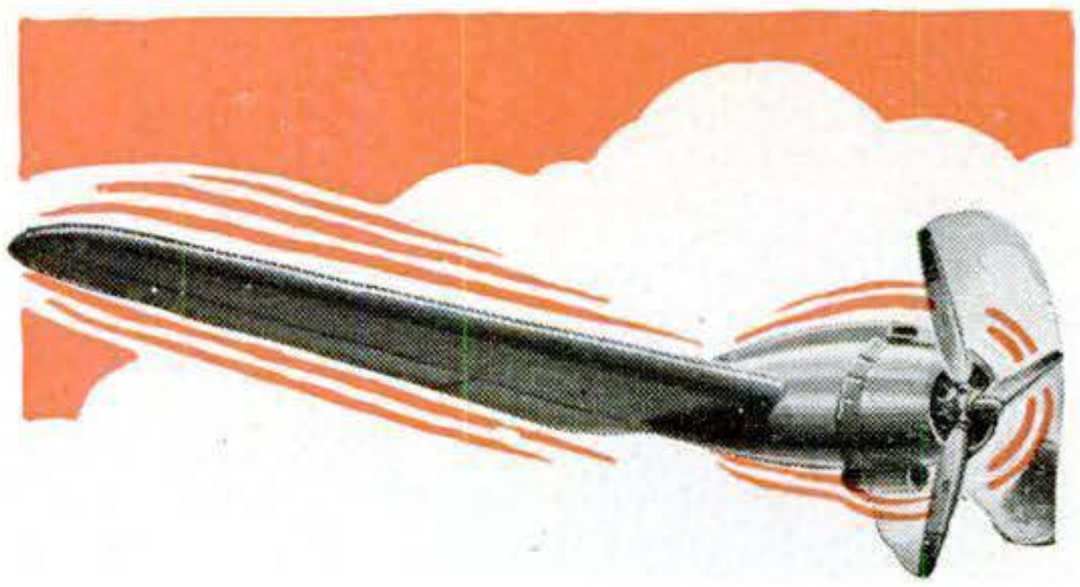
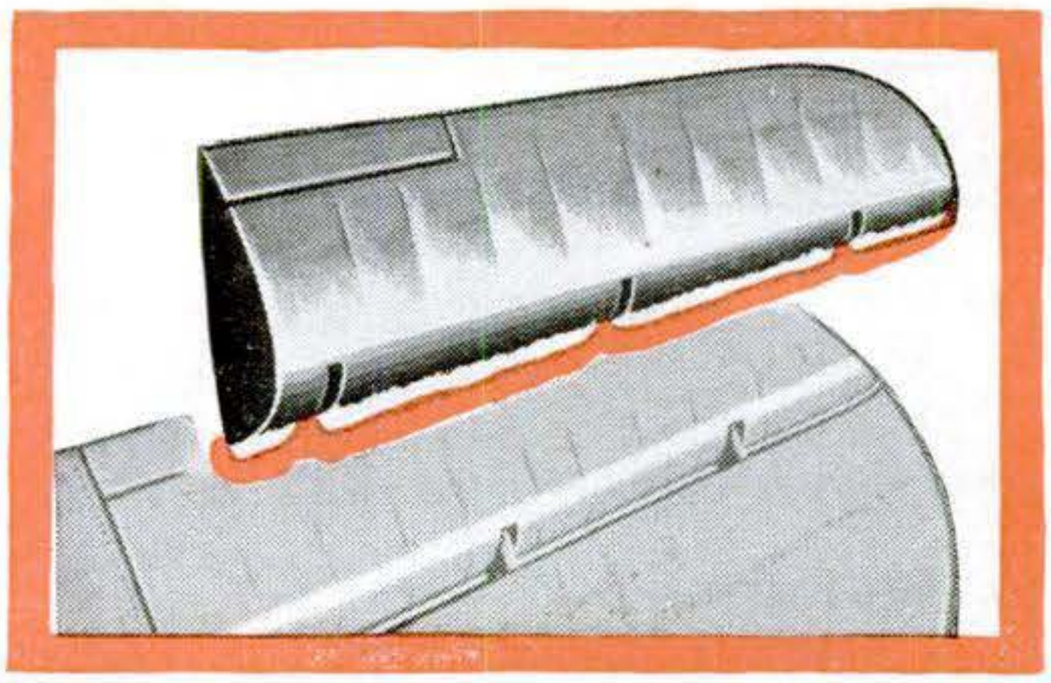


A propeller that is not fully feathered, so that it turns when engine is dead, may set up dangerous wing vibrations. After a crash that spoiled a long record, government required full-feathering props.

of the cabin wall and set fire to the plane's soundproofing material. The hydraulic fluid had fed the fire.

Sometimes the investigators have to arrive at a "probable cause" by piecing together bits of eyewitness testimony that are numbered by the score. On Aug. 31, 1940, an air liner bound from Washington, D. C., to Pittsburgh, Pa., reported in by radio at 2:31. Ten minutes later, it dived into the ground near Lovettsville, Va.

All of its 21 passengers and the crew were killed. Aboard had been a United States senator and an agent of the Federal Bureau of Investigation. A story got out

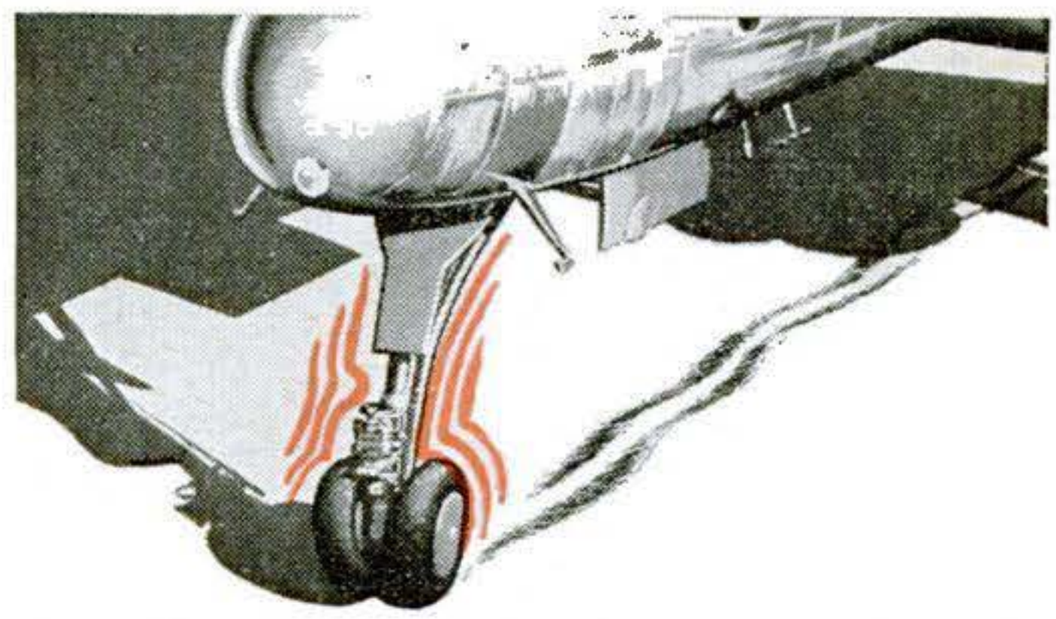


When investigators found ice wedged between an aileron and trailing edge of the wing, in a bad crash near Pittsburgh, the solution was simple. The frozen aileron prevented lateral control. The Pittsburgh accident led to redesign of aileron.

that the senator's life had been threatened. Moreover, the FBI man was on an important case. Could this accident have been sabotage, intended to kill either man at the expense of a whole planeful of passengers?

Both the Accident Investigation Division and the FBI moved in. No evidence of structural or power-plant failure was found. Working together, the two agencies did find a part of one of the engines 1,200 feet ahead of the point of the crash. In coming to earth it had clipped off progressively longer pieces of corn stalks in its path. Once its trajectory had been fixed, its velocity was easy to estimate. The investigators found that the plane had crashed going about 300 m.p.h. That was 120 m.p.h. beyond its normal speed in level flight.

The speed at impact was of only passing importance. It indicated the plane had gone in under high engine thrust, probably at full throttle. But why? Witnesses were sought.



Wavy line on runway shows that plane's tricycle landing gear suffered from front-wheel shimmy. In one case, this wrecked interior and ripped fuselage. Skirts of pistons in shimmy damper expanded and seized in cylinders, holding nose wheel.

One woman testified that she had been on her back porch, about three and a half miles east of the scene of the accident, when she saw an airplane flying toward storm-crowned Short Hill. Suddenly she was blinded by a lightning flash "just a little bit ahead" of the airplane. After that she heard an "awful roar."

Many witnesses had seen that flash of lightning. With a surveyor's transit, the investigators estimated both the altitude of the transport and the approximate position of the lightning flash with relation to it. The finding, labeled "probable cause":

"There was no sabotage. The airplane was not actually struck by lightning. The airplane was in some fashion affected, or the pilots disabled, by some effect incidental to a stroke of lightning, such as its mechanical effect on the airplane, or acoustical shock, concussion, or optical impairment of the pilots."

A study of the effect of lightning on aircraft and their operating personnel forthwith was instituted.

Accident investigation often means plain

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investigators look for marks made by the revolving propeller blades striking the ground at intervals just before crash. Distance between them may indicate how fast plane was traveling and how rapidly the engine was turning over.

drudgery. When a nonscheduled transport crashed last June near Richmond, Va., killing 27 persons, five Division men converged on the scene. The airplane had burned on impact. Little was left of it. For days the five men tramped through the surrounding woods. They had to cover a radius of five miles from the site to be sure they hadn't overlooked anything. They had only one solid clue—the pilot had radioed that he was having engine trouble.

The propeller blades were found in six feet of mud and water. They had to be dug out. The airplane's two engines had buried themselves so deeply that it took a bulldozer three days to withdraw them. Skids had to be built to haul the engines to a road and thence to an airport for examination.

The right engine showed no evidence of mechanical failure. But the cockpit yielded a clue. The ignition switch for the right engine was in the off position. Moreover, the mixture control for that engine was in the idle cut-off position, and the rudder trim tab was set for left-engine operation. It was obvious that the right engine had been shut down, for some reason.

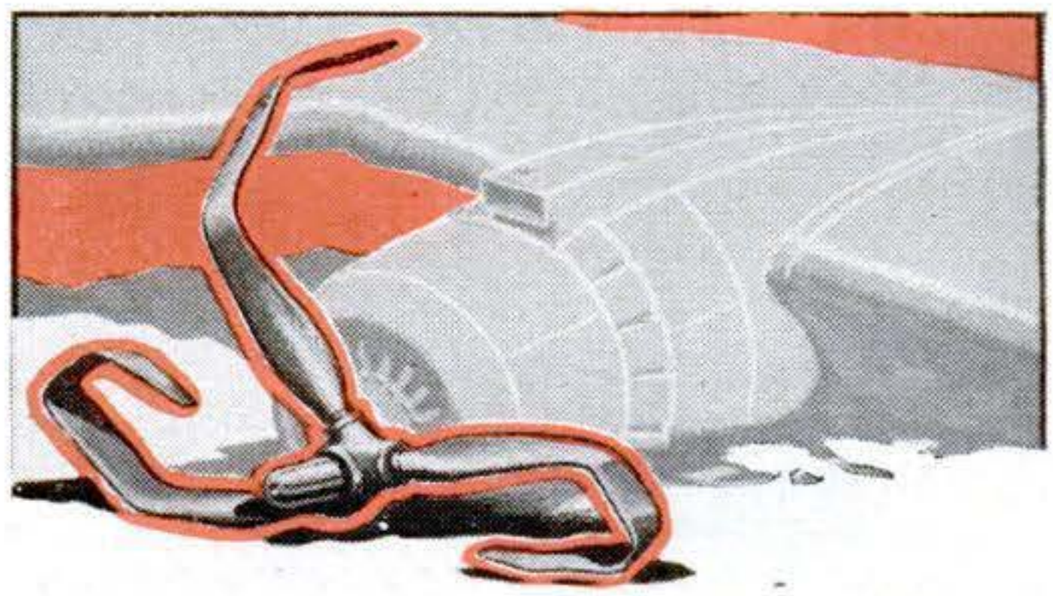
The rest of the story was in the left engine. The worn, shiny appearance of a rocker arm, cam follower and tappet indicated that the valve mechanism on one cylinder had been loose for some time prior to the crash. The operation of a heavily laden plane on one engine with an ailing cylinder had been impossible.

The solutions to the majority of accidents are simple. When an air liner crashed near Cheshire, Conn., a year ago this winter with the loss of all aboard, examination of the wreckage and the testimony of witnesses showed conclusively that a fuel fire had burned off the left wing. The probable cause was a failure of a fuel line or fuel-line connection.

When another transport experienced what its captain at first thought was engine trouble after a take-off from Jackson, Miss., for Birmingham, Ala., an examination of the propellers showed that their tips were curled like pretzels. How had that happened? The investigators logically examined the airport runway at Jackson. Propeller marks on the pavement proved that the co-pilot had upped the landing gear too soon.

At Wichita, Kan., one airplane taking off at night collided with another parked on the runway waiting for a radio message. Nobody was hurt but both machines were chewed up. The pilot of the moving plane had mistaken the unblinking white taillight of the other one for a field boundary light. That accident led to the installation of today's flashing navigation lights on all scheduled transports.

A plane which took off from Las Vegas, Nev., at night and flew as straight as an arrow into a mountain 33 miles away had the makings of a good mystery until the investigators took a routine look at the pilots' flight plan. The men in the cockpit had entered on the flight plan their intention of flying a compass course of 218 degrees. The airway compass course they should have followed was 210 degrees. That eight-degree error cost the lives of actress Carole Lombard, 15 Army Air Forces men, three other passengers and the crew.



Another clue to engine speed is the condition of the propellers themselves. The faster the engines were turning over, the more the propellers are chewed up by striking the ground. Wreckage such as this is always kept under guard.

A crash near Atlanta, Ga., in which Eddie Rickenbacker, air-line president, was hurt, was traced to nothing more complicated than the transposition of two figures in the barometric setting on the airplane's altimeter. That gave the pilot an incorrect altitude reading.

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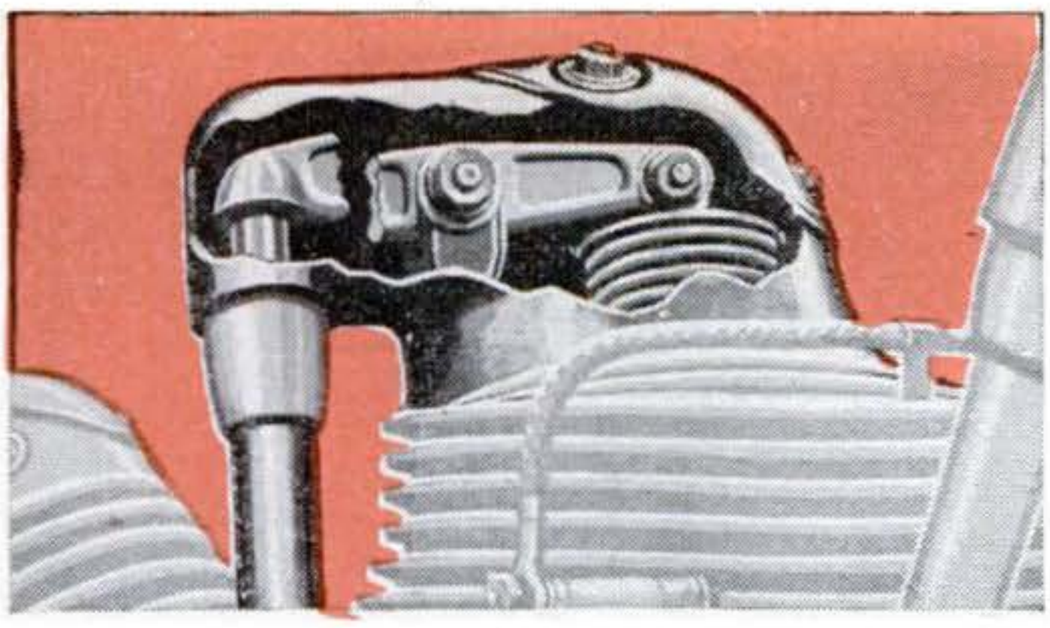


Engine trouble is one of the easiest accident causes to run down, since strength of parts usually preserves them for inspection. Artist has shown a broken rocker arm. This defect would put cylinder out of commission, since valve would not operate.

Some accidents remain mysteries. Yet wreckage that fails to surrender an answer is rare. To the men of the Division the telltale fingerprints of mechanical or structural failure are legion. They know human nature, too. They can spot poor pilot judgment a mile away—and they know that the pilots of small, personal airplanes almost invariably blame their machines for their mishaps.

Occasionally, they run across a bona fide reason for a lightplane crash, apart from poor judgment. One crash that took two lives was a sticker until an investigator began probing around in one of the wing tips. There he found a mouse's nest. Looking further, he found that the stitching used to tie the wing fabric to the ribs had parted. It was not frayed—it was cut clean by sharp teeth. When the plane took off, the fabric parted from the wing.

A report by a woman pilot that she spun into the ground because she couldn't get a rudder pedal to work led another investigator to comb the wreckage of her plane for the cockpit floorboard and rudder-pedal assembly. He found the heel of her shoe had caught in a footrest behind the pedal.

The investigators—pilots, every man of them, each with thousands of hours of flying—have an abiding respect for aircraft. They know that in speed there is danger, be it in automobiles or aircraft. They are a little wacky about their work—proud of what it means in terms of safer aircraft—and proud of their precision.

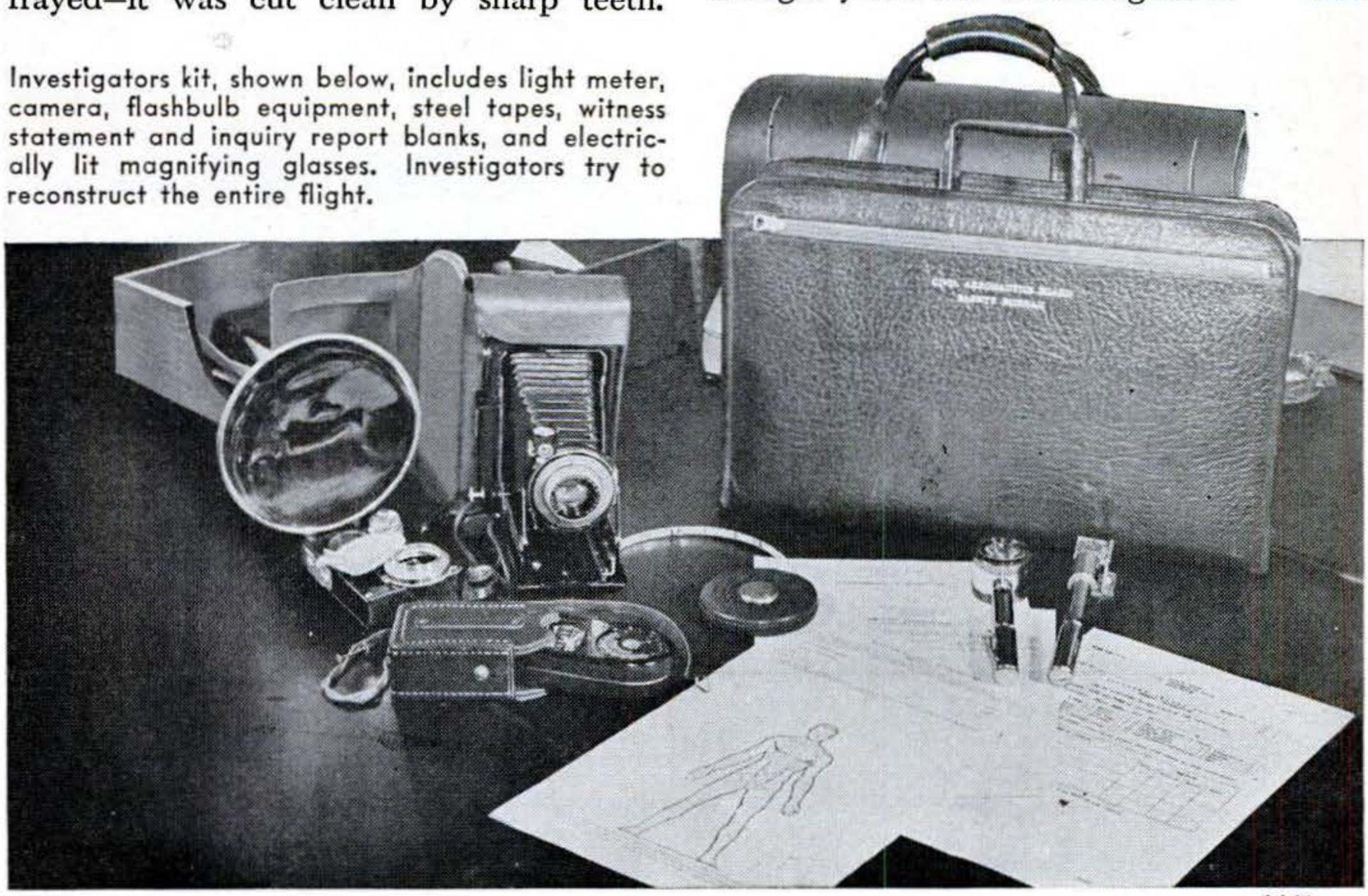
In the Washington office of Paul Gillespie, Division chief, Popular Science Monthly asked if a hypothetical crash problem could be worked out on the spot. Mr. Gillespie called in a statistical expert, who arrived looking apprehensive.

"If an airplane with three-bladed propellers turning at 1,700 revolutions a minute crash-landed at a speed of 180 miles an hour," he was asked, "how far apart would be the marks on the ground made by the propeller tips?"

The man whipped out his slipstick, figured on a pad for a few seconds, and replied, "Three and a tenth feet."

Then he relaxed. "Gosh," he said, "I thought you'd ask something hard." END

Investigators kit, shown below, includes light meter, camera, flashbulb equipment, steel tapes, witness statement and inquiry report blanks, and electrically lit magnifying glasses. Investigators try to reconstruct the entire flight.



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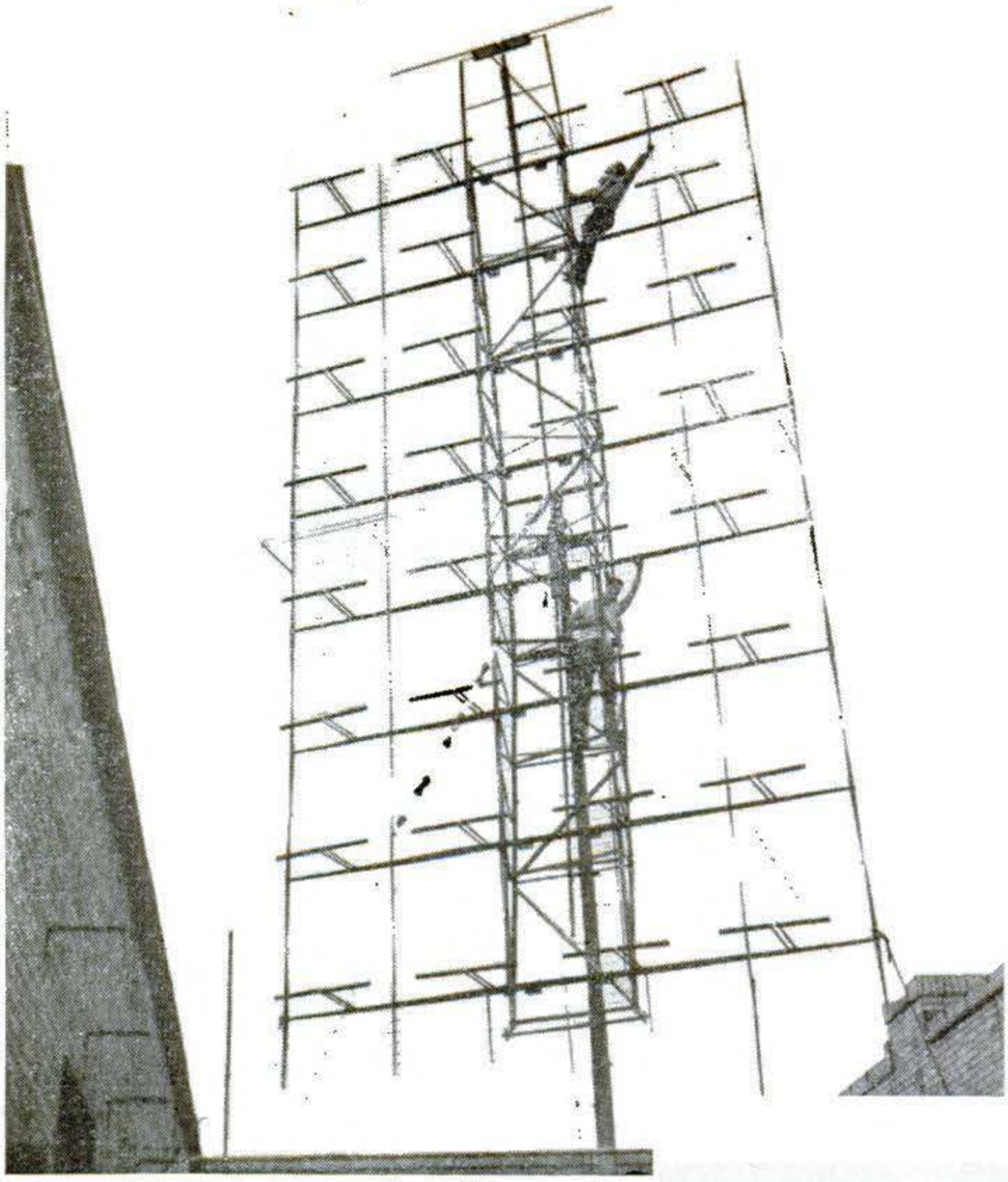
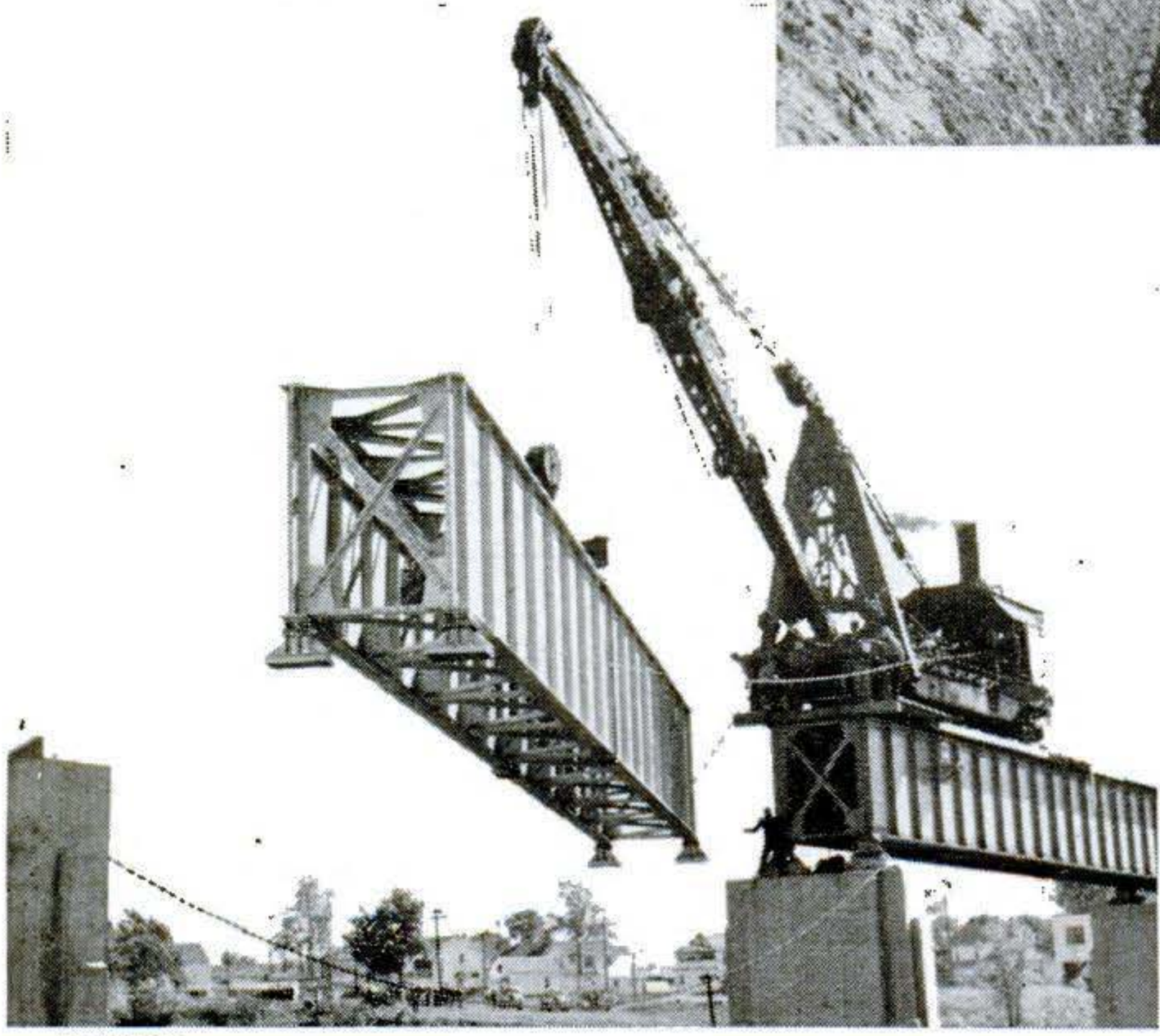


Veteran at New Job. A replica of the radar antenna that shot the moon a year ago has been erected 43 stories above midtown New York. Essential to a project of FM station WBAM, the antenna was recently released from the Army. It faces Washington, D. C., and tests the effect of weather, sunspots, seasonal changes, and cosmic and magnetic storms on the new and old FM bands—47.1 and 106.5 megacycles, respectively. Perched 500 feet above the street, the antenna increases transmitting power 60-fold.

Trench Hoe. What wouldn't an infantryman have given for the machine at the right? The big hoe, powered by a Caterpillar Diesel D4400 engine, has a half-cubic-yard bucket and digs 400 feet of 3½-foot ditch in an hour.



Aluminum Span. Crane at left is swinging a 100-foot, all-aluminum girder into place on the first aluminum span in history. The new Grasse River bridge of the Messina Terminal Railroad at Messina, N. Y., has two such girders. Each weighs 53,000 lb. (a steel one would weigh 128,000 lb.), permitting complete shop fabrication. Aluminum Co. of America designed the girders and Bethlehem Steel Co. fabricated them.

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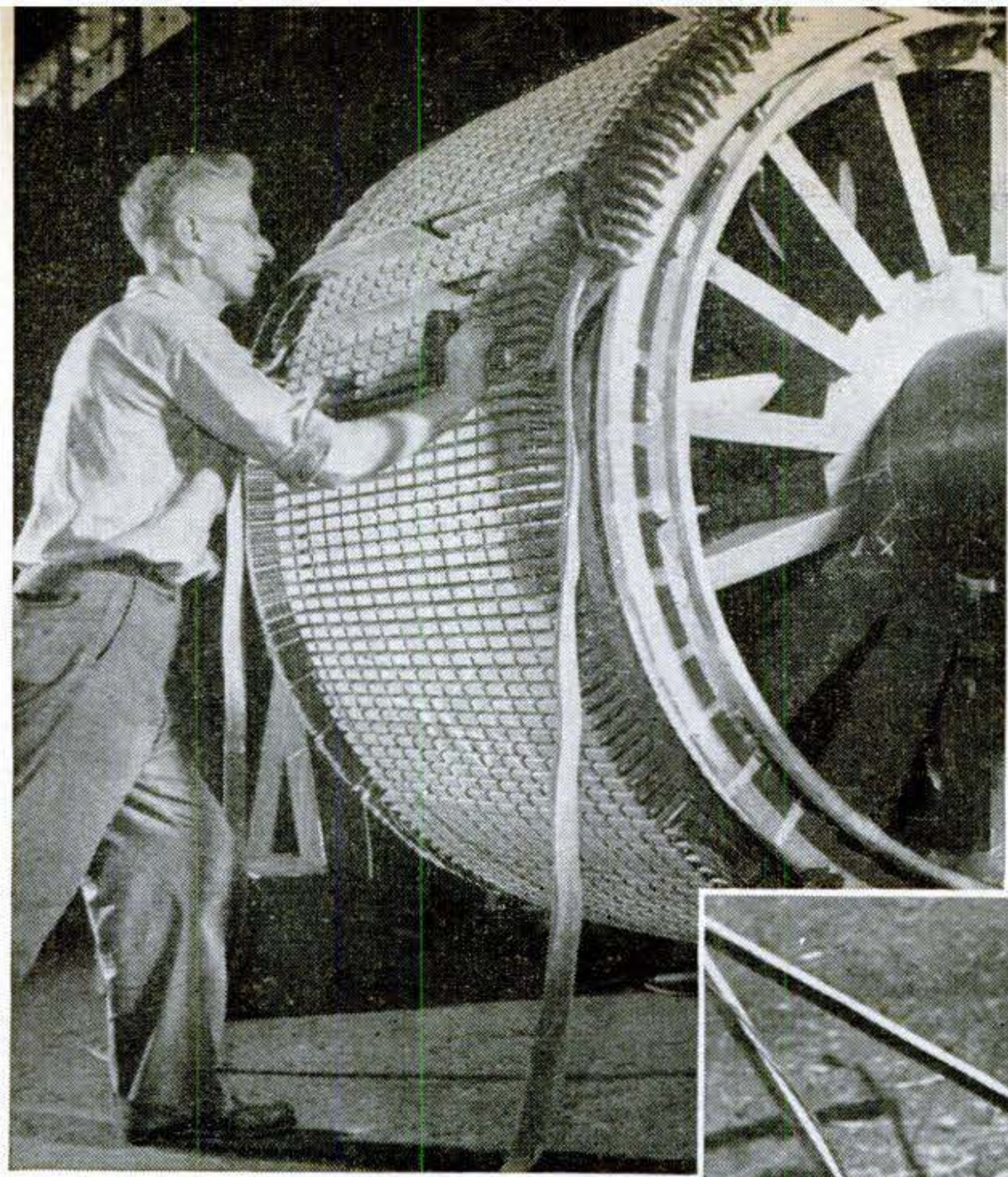
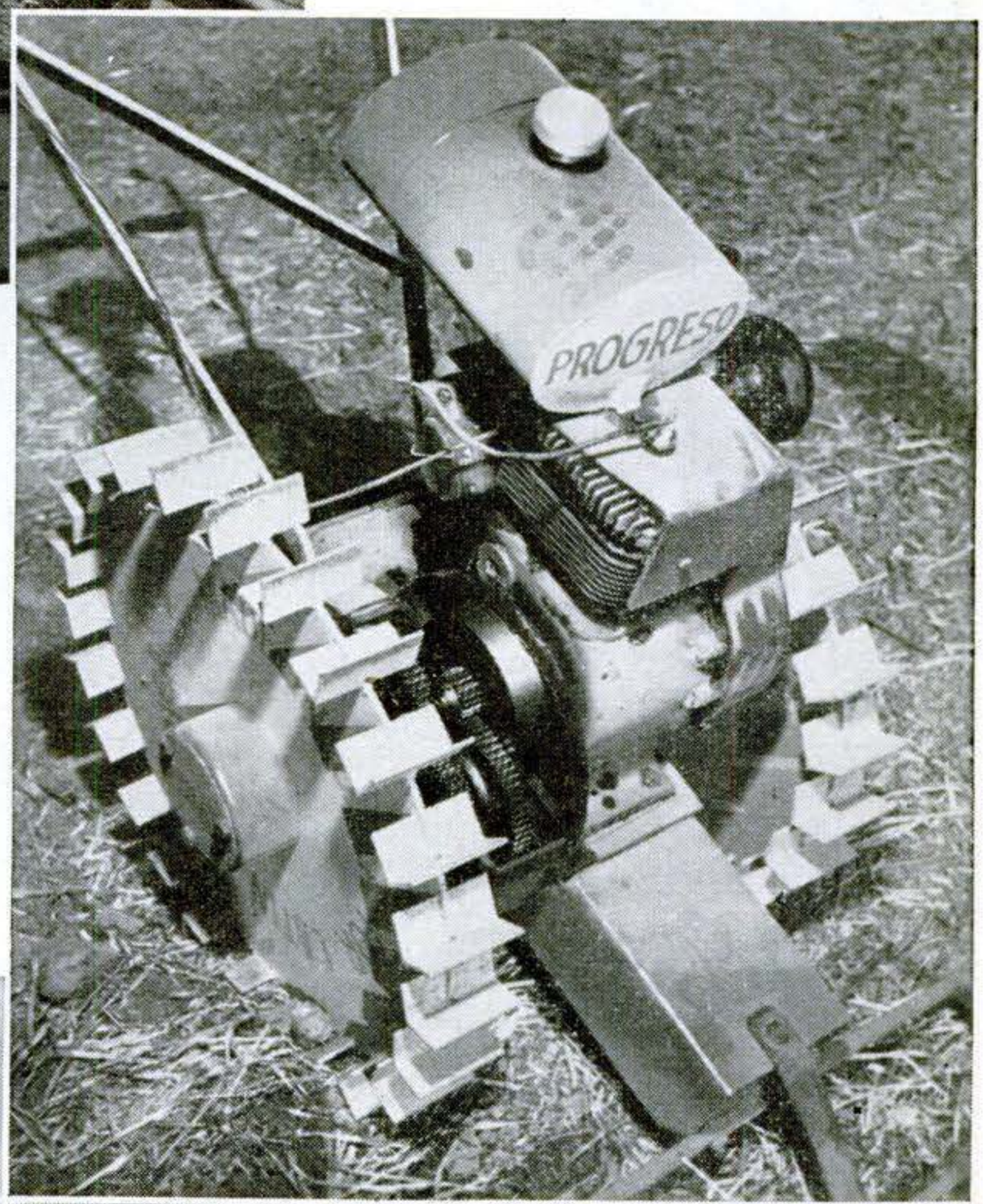
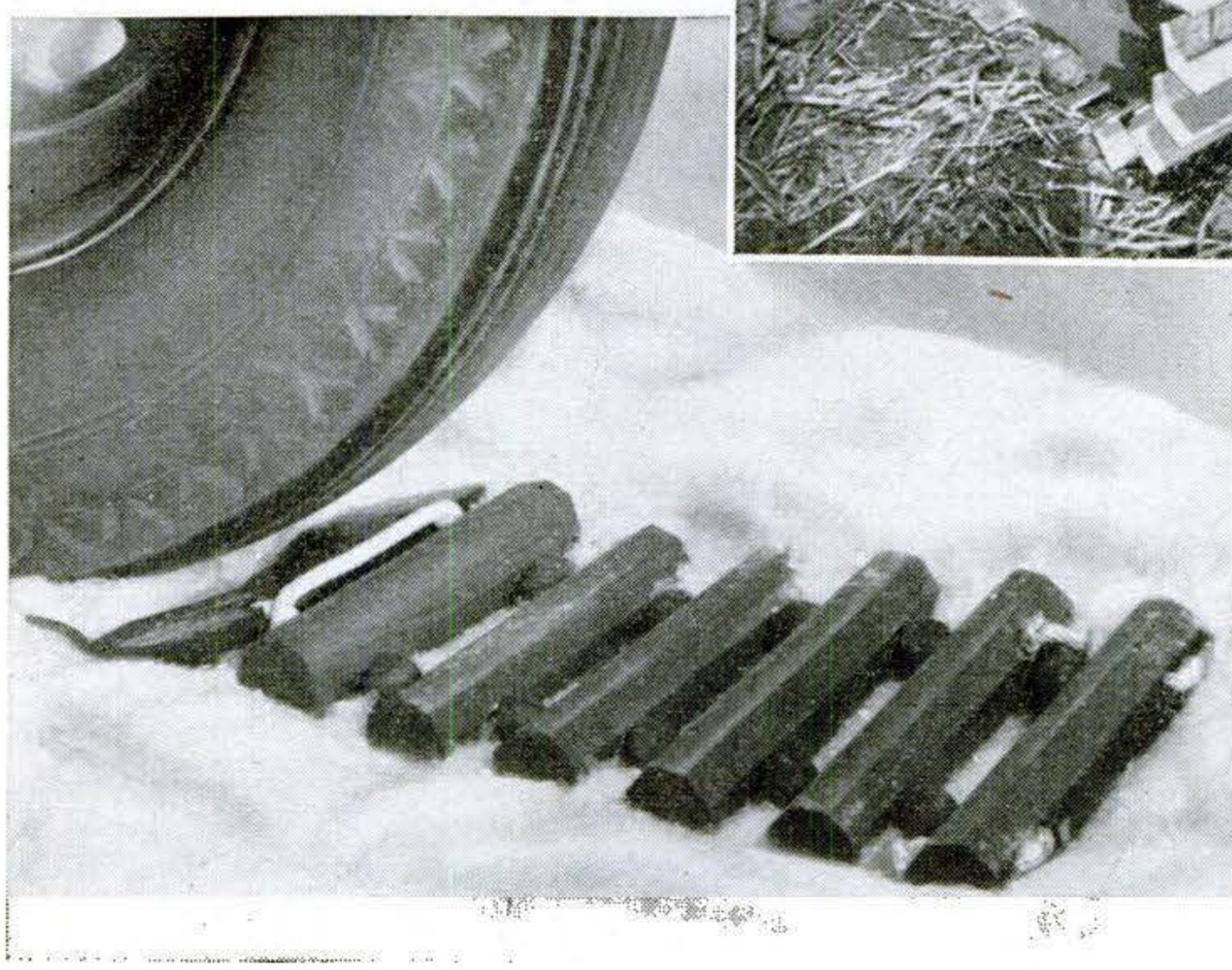


Rotor for Motor. A workman at left places copper coils in the huge rotor of an electric motor that will end up in some automobile or steel plant. Developing 3,000 hp., the motor can lift 10 tons 82½ feet in a single second. The rotor will spin 120 r.p.m. in its stationary housing. It was built by Westinghouse at its factory in East Pittsburgh.



Tractor for Latins. The tractor at right is made in U. S. A. —but you can't buy one here. When the Progreso Industrial de Mexico, S. A., was unable to buy tractors here it started to make its own in this country, exclusively for export to Latin America. The tractor's one-cylinder engine develops 14 hp. at 4,000 r.p.m., burns gasoline or kerosene. It can use Ford parts.



Car Snowshoe. Constructed along the lines of a tractor tread, the "snowshoe" at left was designed by the Brown Fence & Wire Co., of Cleveland, Ohio. It furnishes traction for autos in trouble in snow, ice, mud or sand, when placed under one of the rear wheels.

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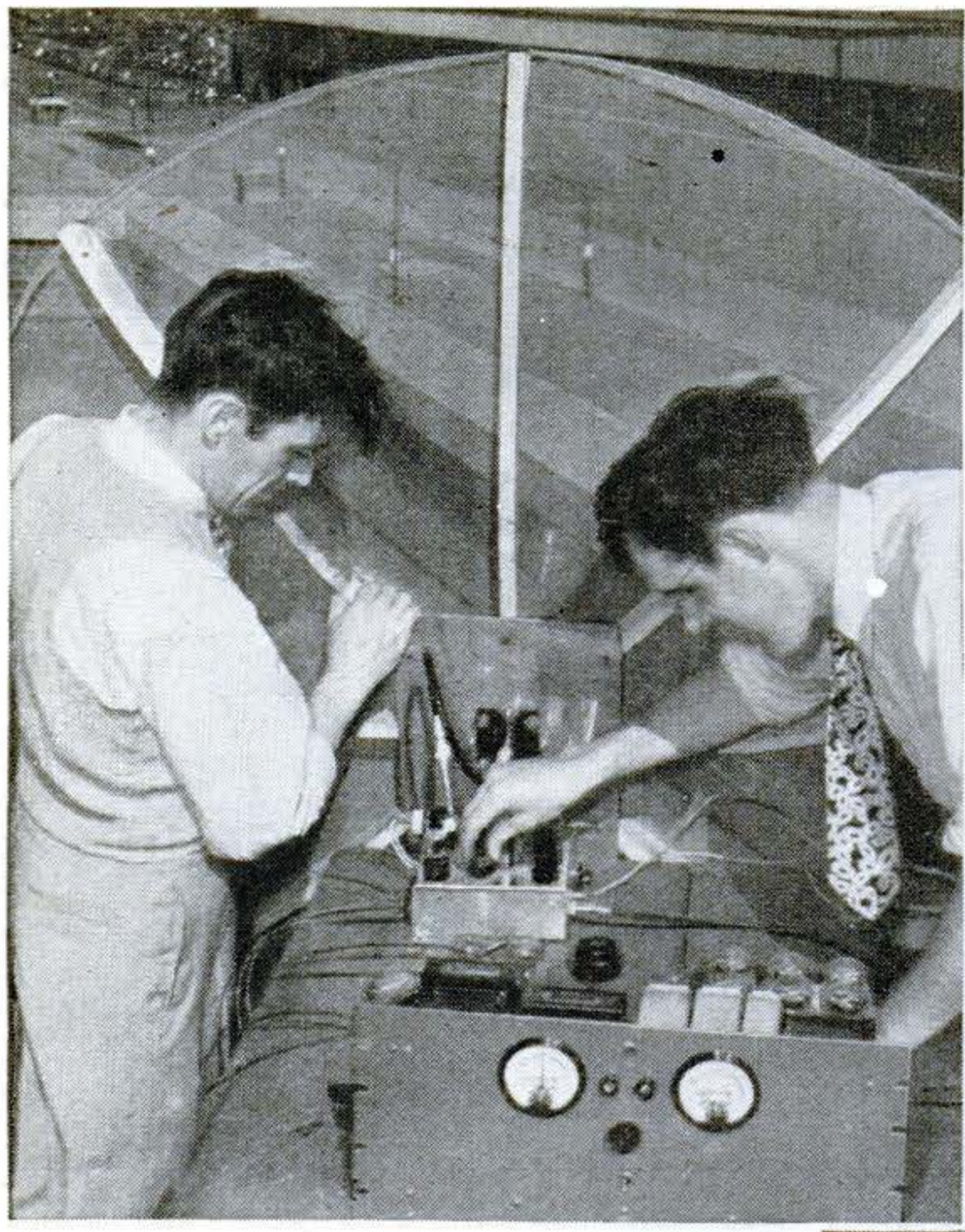
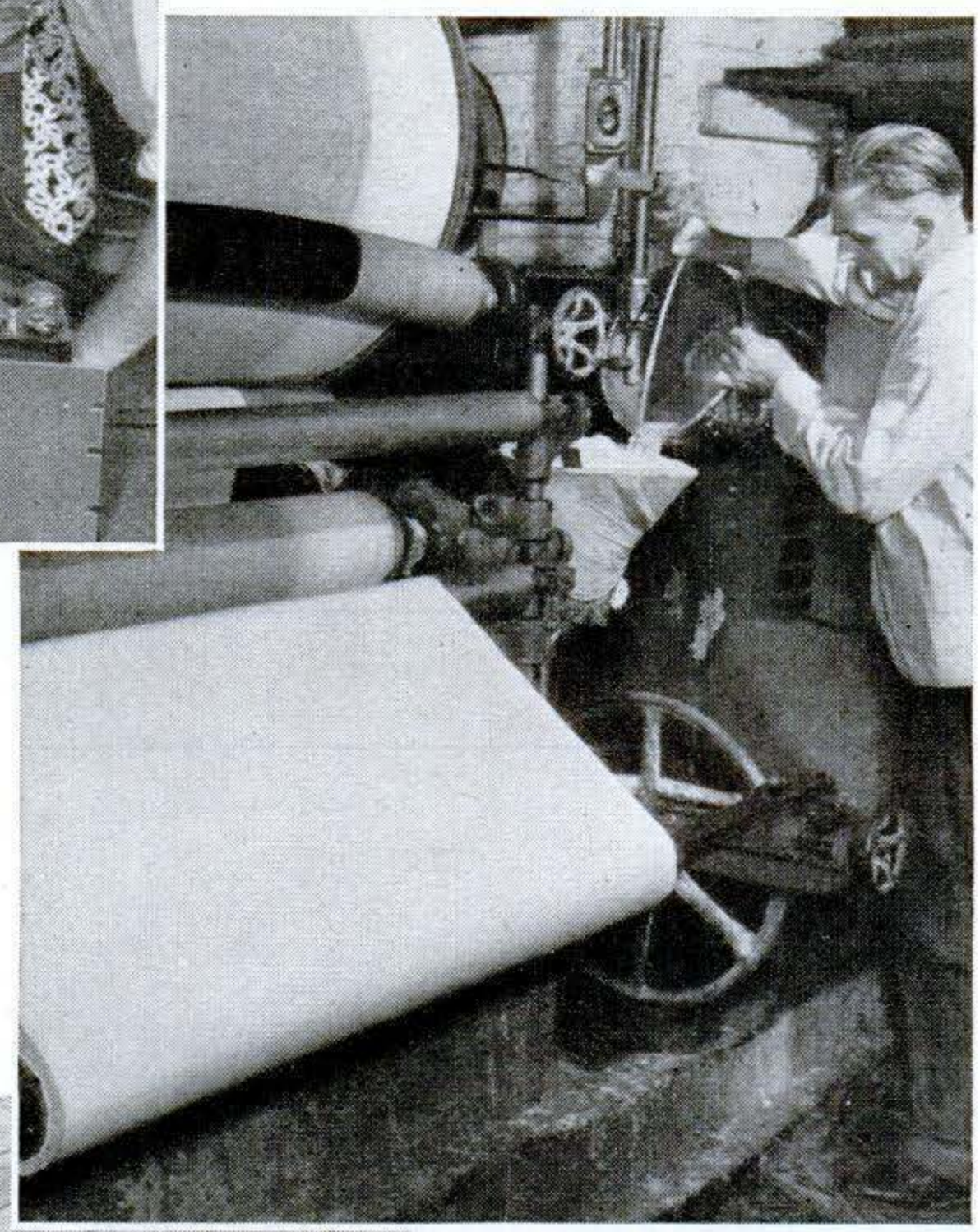
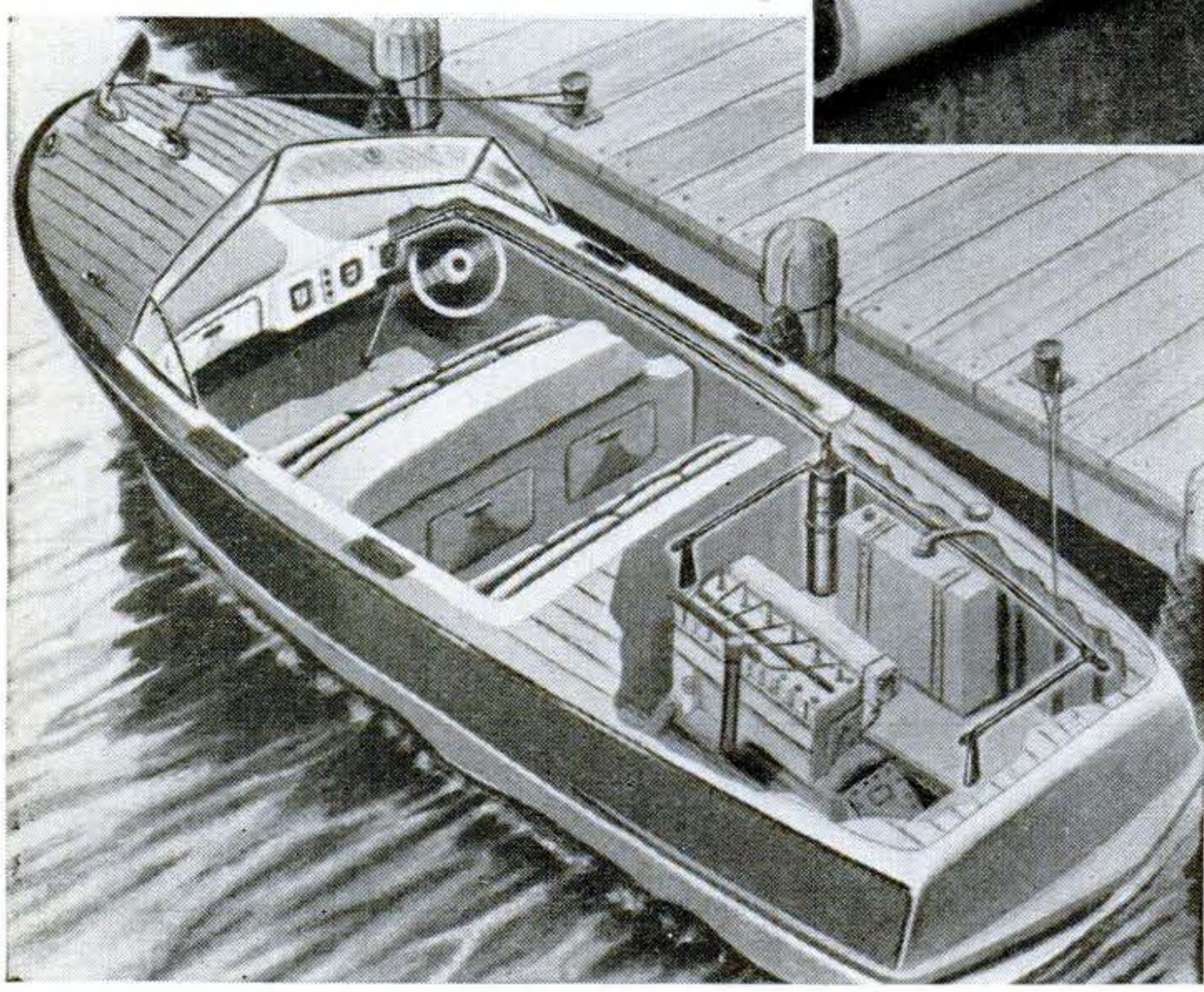


Ham Pioneers. First to use the UHF 2,300-2,450-megacycle band transferred from radar to ham radio operators were George H. Floyd and Arthur R. Koch of Schenectady, N. Y. Photo at left shows Koch inserting a "lighthouse" tube in his home-made, ultrahigh-frequency "transceiver." He used ordinary mesh screen for a parabolic reflector, and part of a tomato can as reflector on a radar-type antenna.



Plastic Fights Wrinkles. Resloom is a new Monsanto soluble resin that helps washable rayons, woolens and cottons resist wrinkling and shrinking. Cloth is dipped into Resloom and passed through rollers (right). After 30-minute cure in 350°F. ovens, fibers cling to hard but pliable plastic "skeleton."



Smothers Fire. Small motorboats can now have the same fire protection as larger craft with the new Kidde extinguisher. The system (left) consists of a container, holding 10 pounds of carbon dioxide, connected to two nozzles. In case of fire, the driver pulls a lever on the control panel and the CO_2, activating itself, floods the engine compartment and smothers the blaze.

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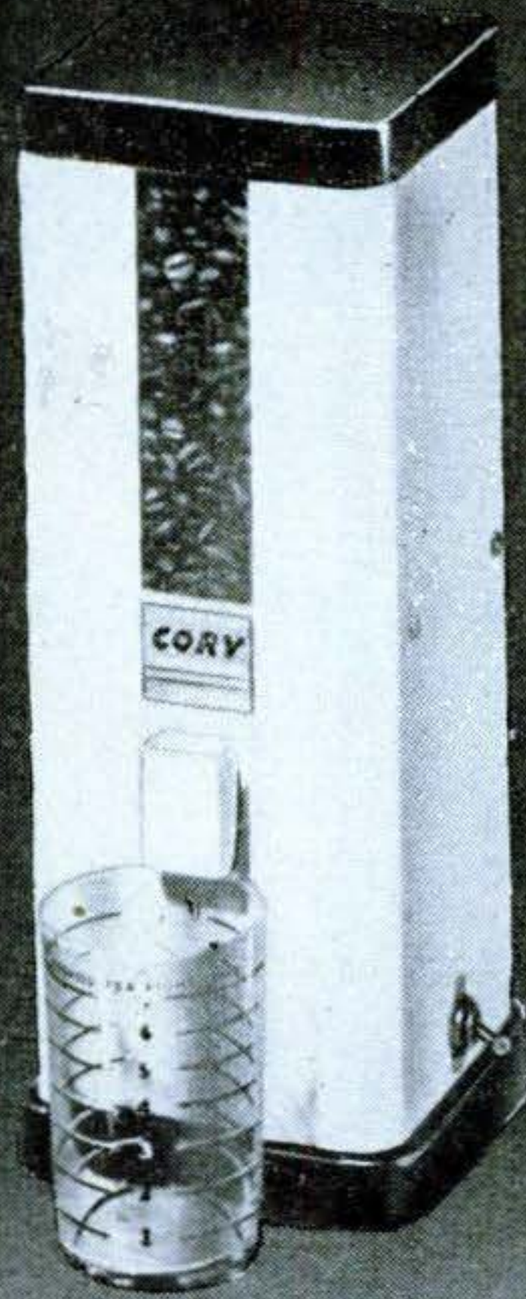
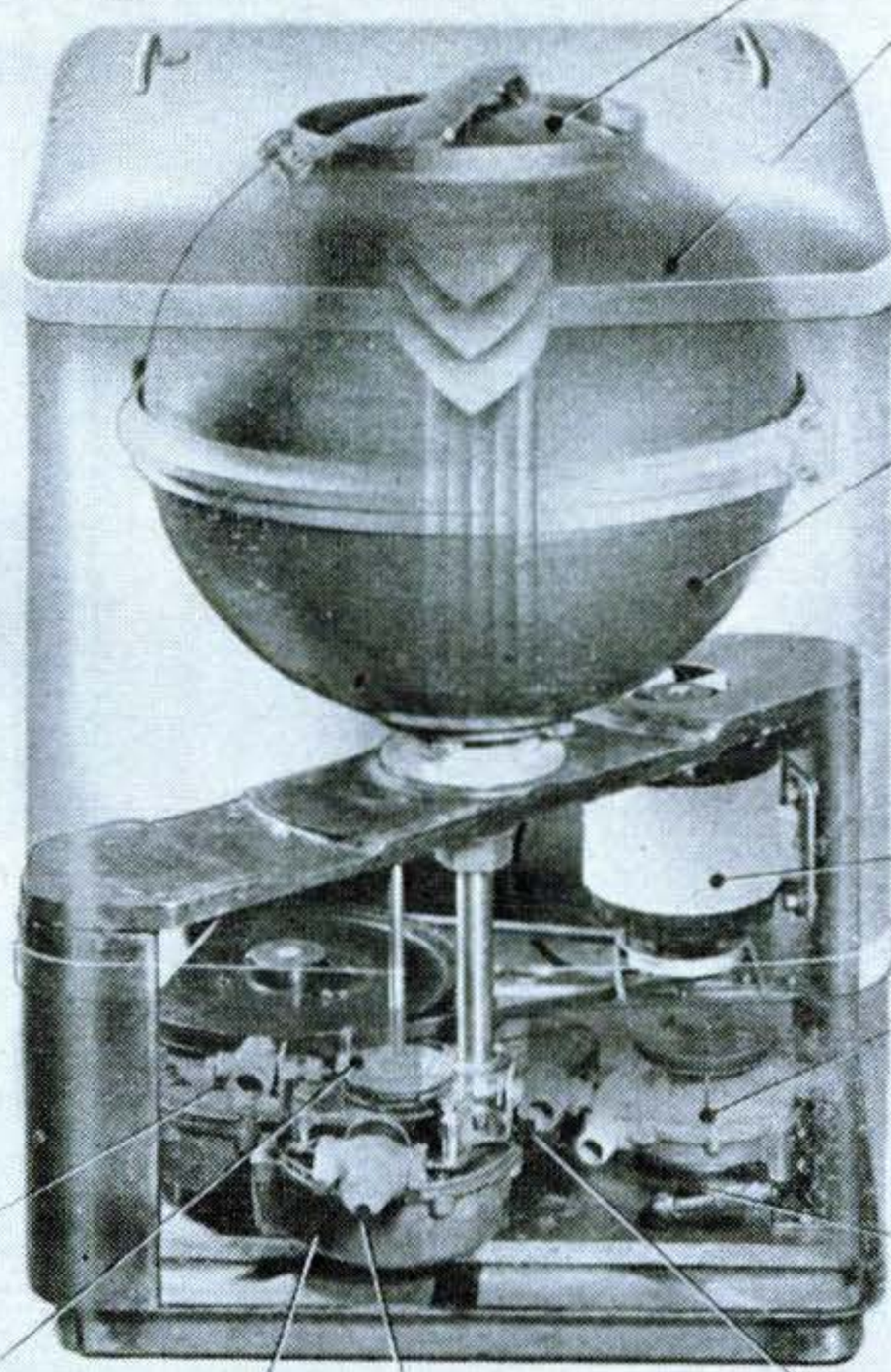
SERVANTS from the Laboratories

Add the Cory automatic brewer, at left, to the new utensils that make the modern kitchen a pleasure. Merely put in water and coffee. The brewer does the rest, even keeping the coffee at the right temperature.

Designed to supply full-flavored coffee, the Cory AC-DC electric grinder, at right, holds a pound of beans. At the turn of a switch, it delivers any type of grind and any amount desired in a measuring cup.



TEN pounds of clothes are washed, rinsed and damp-dried in 30 minutes by the Akka automatic washer, at right. The machine swishes soapy water through the clothes 144 times a minute. When the washer is done, a rubber lining in the lower half of the sphere hydraulically presses the clothes against the washer's perforated top and removes 92 per cent of the soap. Then the washer rinses out the rest with cold water and, finally, squeezes water from the clothes.



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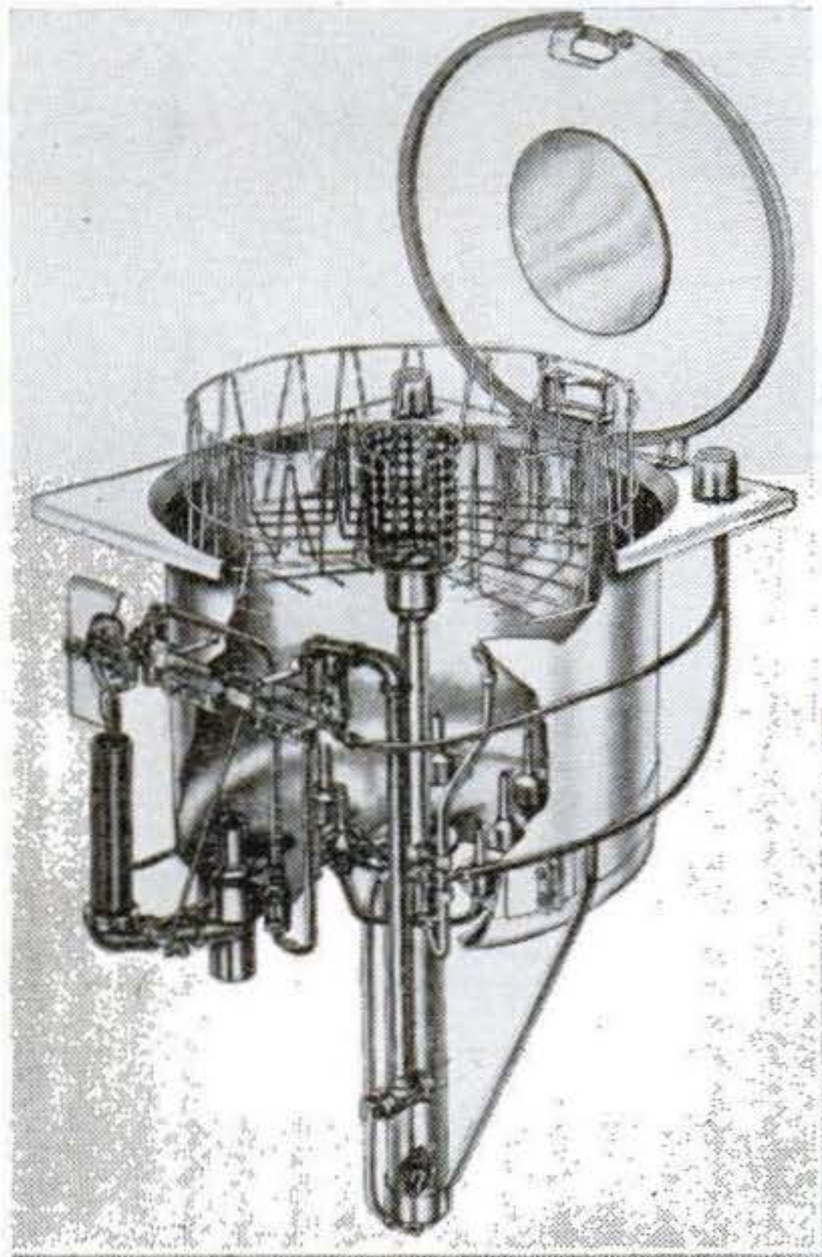
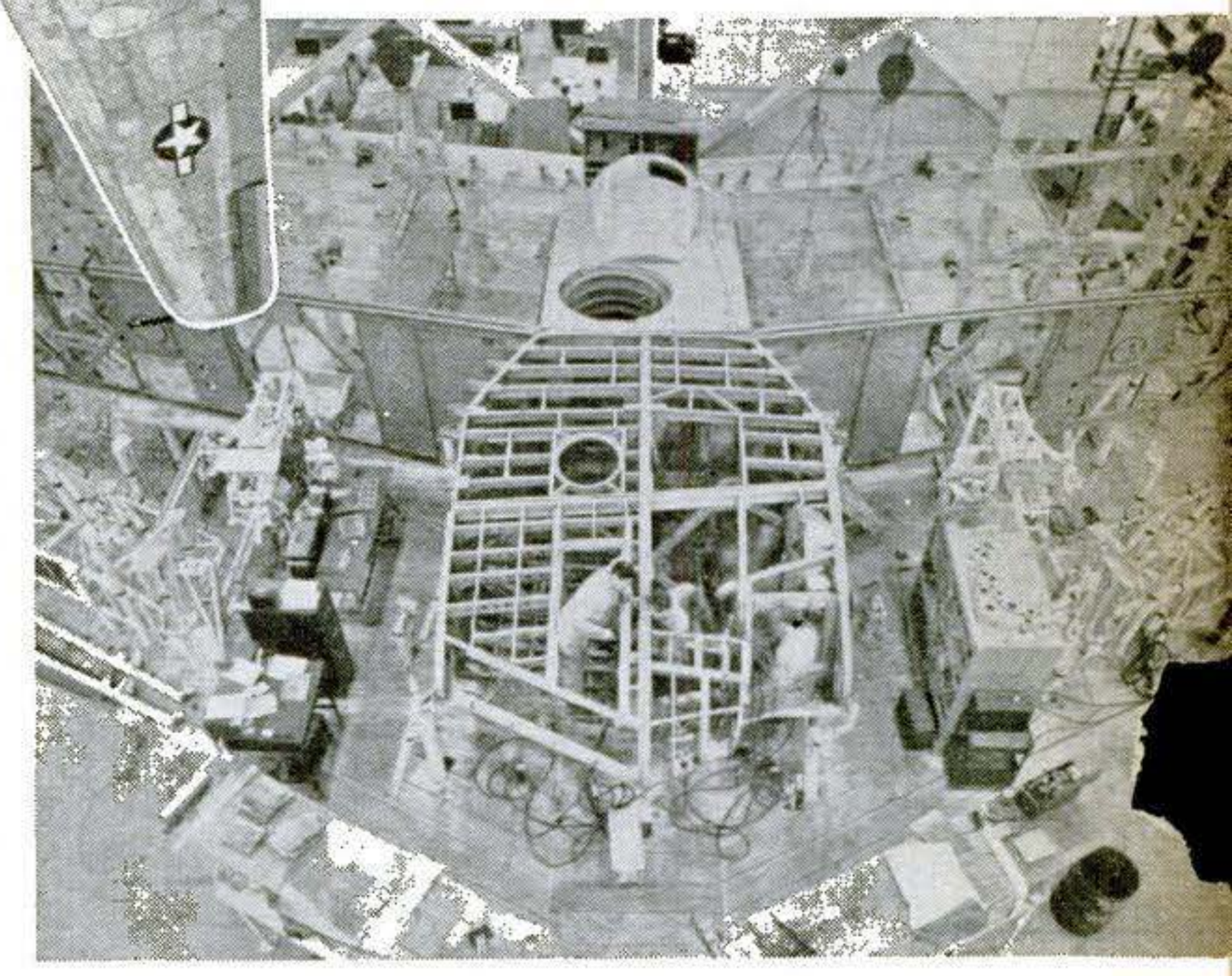
Exactly as radar is directed at an airplane, so energy is beamed from a magnetron tube to food being cooked in the radically new Radarange above. The cooker prepares a hot dog in eight seconds, a six-pound roast in two minutes, gingerbread and biscuits in 29 seconds. The explanation is that the beam heats the interior of the food as quickly as it does the surface. Meats cooked by it emerge gray; baked goods, crustless. Inset at right shows a food container about to be placed in the range. **Produced by the Raytheon Mfg. Co., Radarange will not be available for home use for some time, since the firm is concentrating on supplying commercial food preparers with the ranges.**



Motorless and fully run by normal home-water pressure, the new Kaiser dishwasher at right washes, rinses and dries a service for four in five minutes. It has only two connections, one to a hot-water source, another to a drain. In washing, eight water jets in the chamber spurt water on the dishes, spin the wire dish tray and agitate the washing solution. When finished, the lid is lifted, the tray is raised and the basket continues to spin for two minutes to dry the dishes. The cutaway view in the inset shows the aluminum machine's three controls and its dish basket in a raised position. One control raises the basket, another regulates the flow of water, the third operates the drain.

INSIDE the Flying Wing

Skeleton of crew nacelle, below, shows its position, forward of the big main spar around which the trusswork is built. The cylindrical section behind the nacelle carries the tail cone, which is also accessible to the crew.

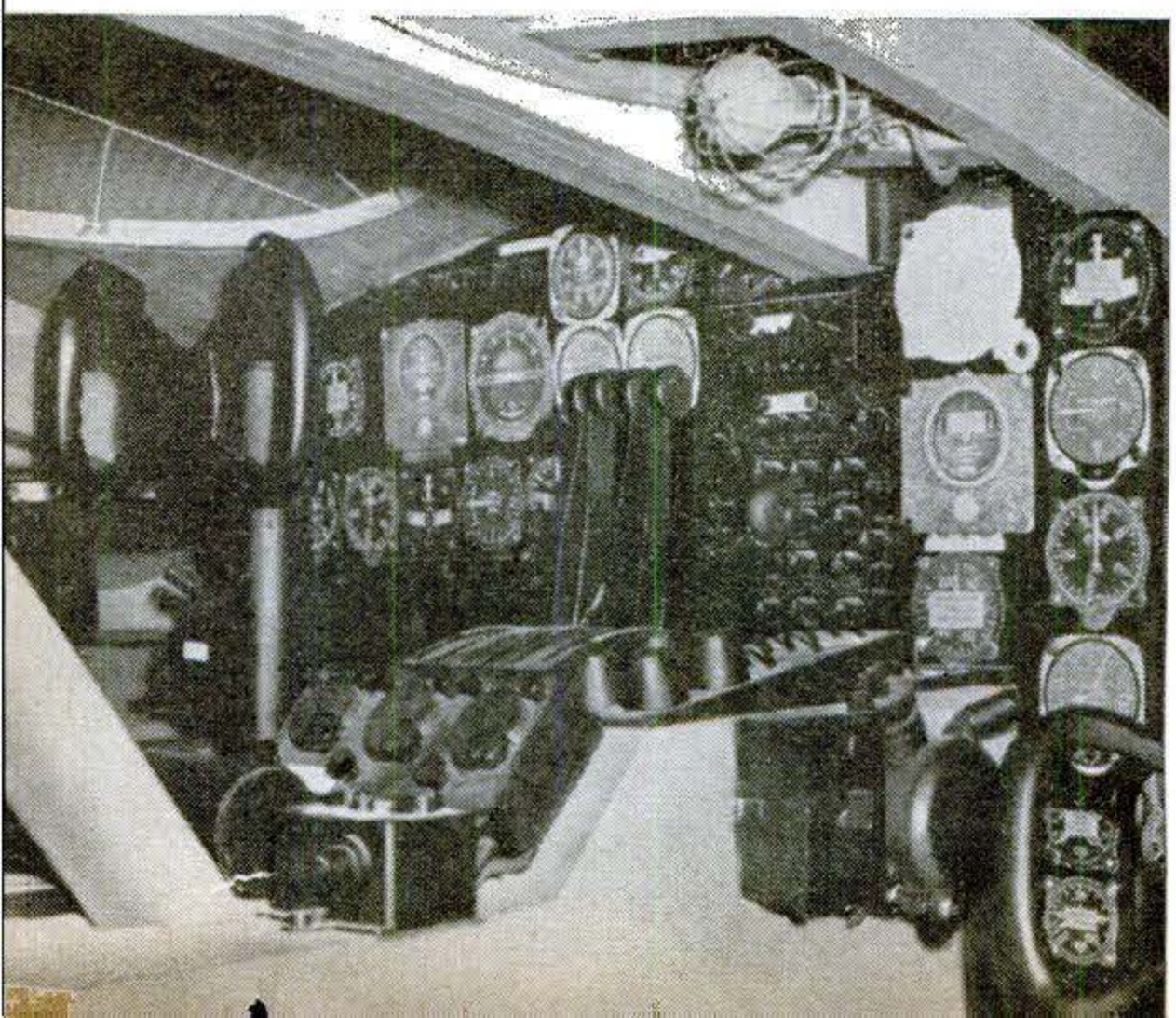


COMPLETELY enclosed within the outer skin of the XB-35 there is a many-sided room that houses the 15-man crew. Pressurized for high altitudes and large enough to provide sleeping accommodations for six, it is the heart of the Flying Wing.

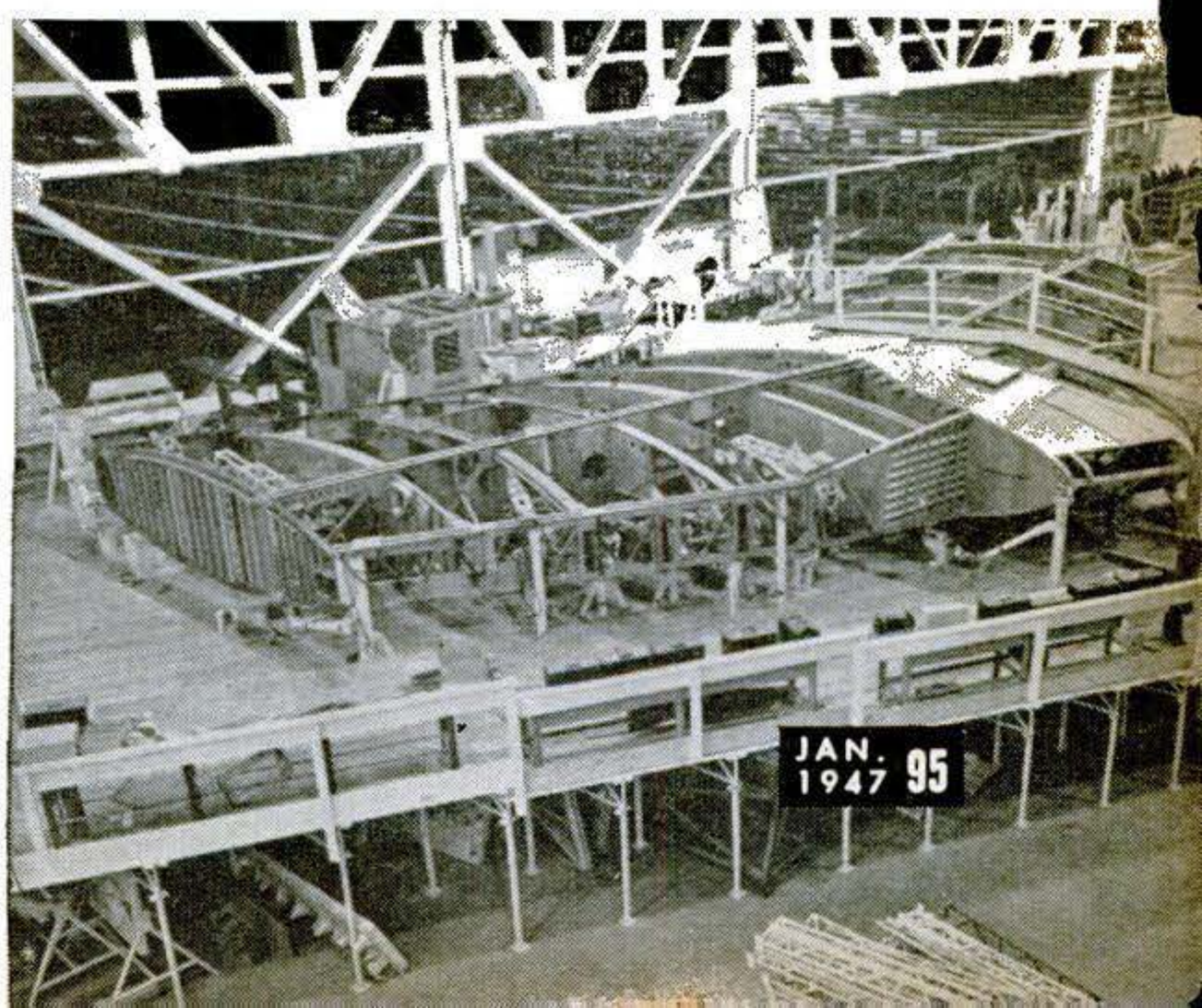
Around this center of operations is a mass of trusswork resembling a bridge—a simpler structure than that of a conventional airplane because the craft's weight is distributed throughout the wing and needs no "beefing up" around a fuselage.

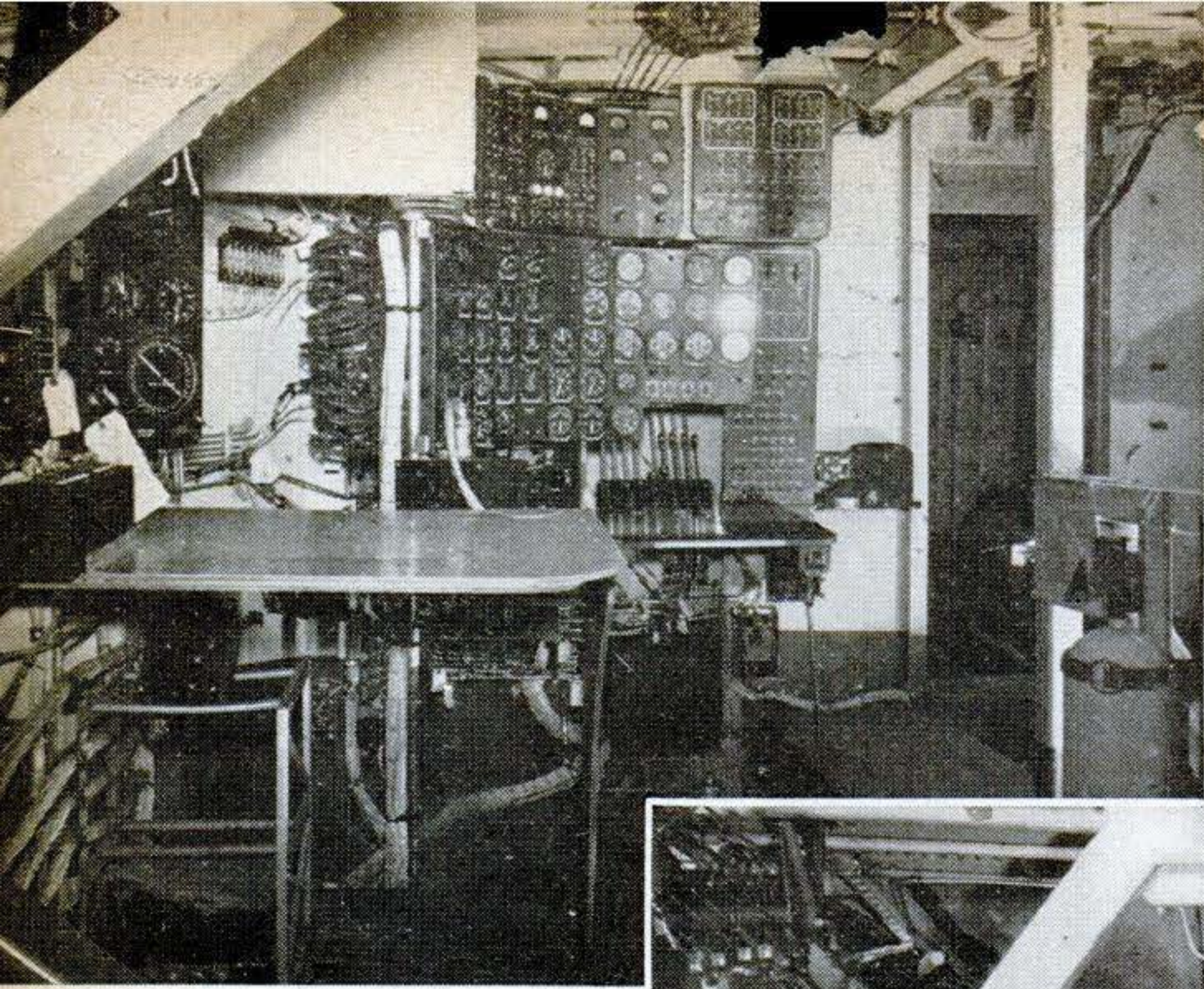
The pictures on this and the following page, taken at the Northrop Aircraft plant in California, show details of the crew nacelle and the massive 172-foot framework in which it nestles.

Instruments and controls of the plane are shown in a full-size wooden mockup. Pilot's wheel is at left, and his head projects up into Plexiglas blister directly above it. Co-pilot's wheel, at lower right, is behind windows in leading edge of wing.

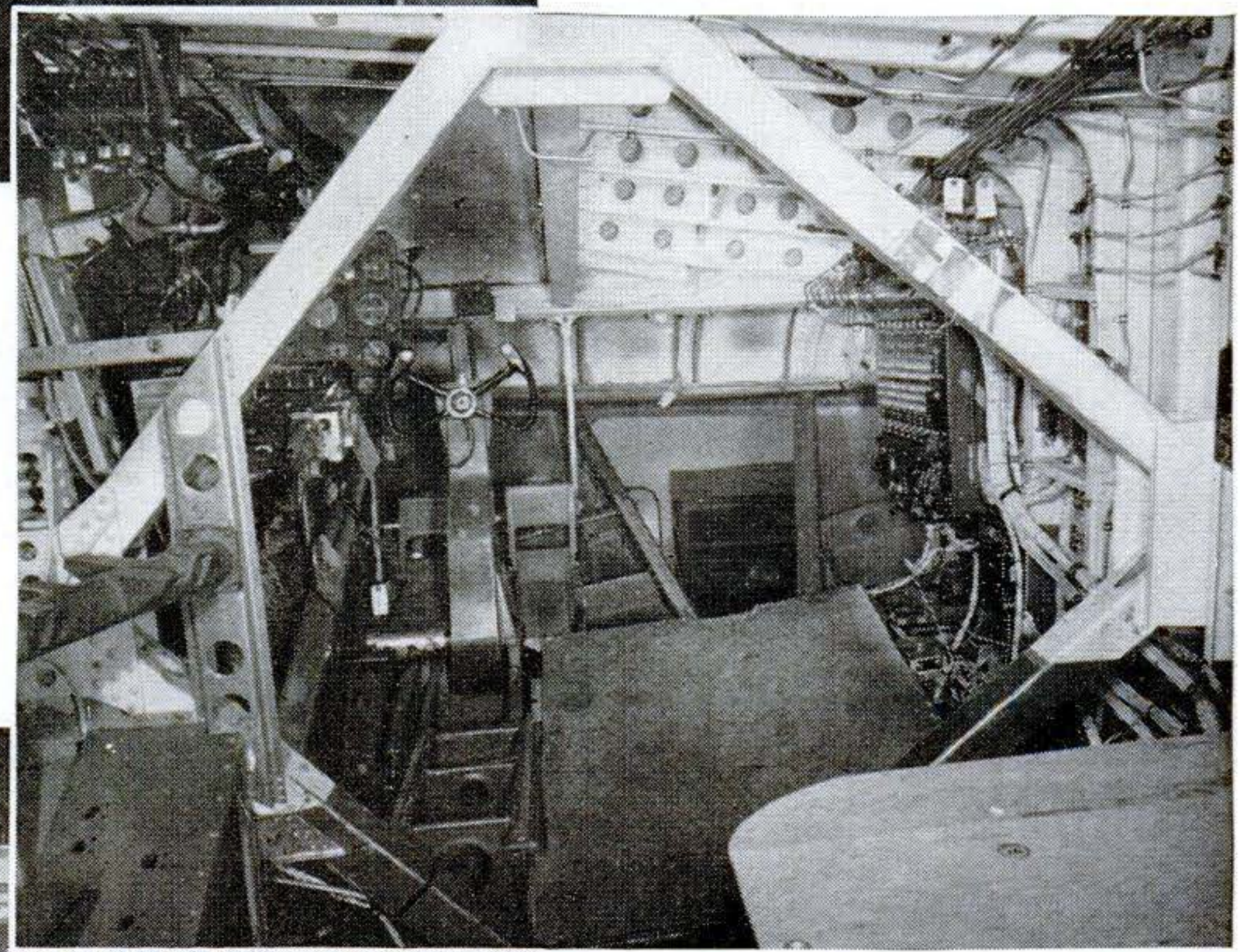


Structural strength of the giant wing is indicated by framework, below, taking shape around the center nacelle. This stage of construction also illustrates relative simplicity of building a plane in which the fuselage is an integral part of the wing.

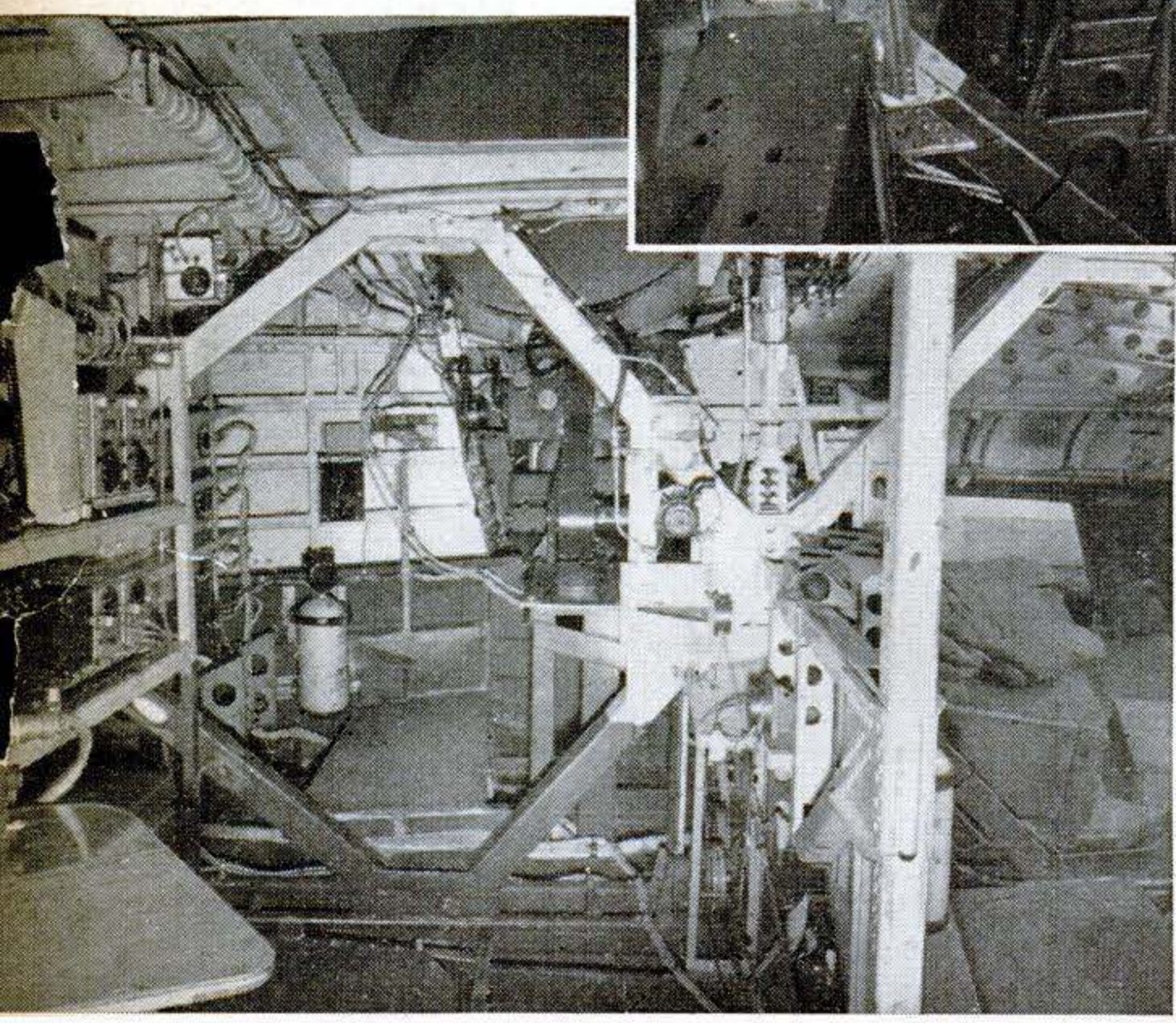




Taken inside the plane itself, the photo at left shows flight engineer's station and the mass of instruments he has to observe to check on plane's performance. The engineer rides backward, about 10 feet behind the co-pilot's seat. The navigator sits near him at the table in left foreground; table is also shown at bottom right of picture below.



The view at right, looking forward to the co-pilot's station, shows location of bombardier's station. The square opening just below and to the right of the control wheel is for a glass panel in the forward wing surface, behind which the bombardier sits or kneels to operate bombsight.



At left is the pilot's station, as seen from center of the crew nacelle. The overhead blister can be seen through the diagonal braces, which partly obscure the control wheel and instrument panel. Table at bottom left is the radio operator's station, shown with some of the flight-test equipment required for early trials of the Flying Wing.

PIN-UP

NORTHROP FLYING WING. First of 15 being built for the AAF, this 172-foot giant's four internal Pratt & Whitney engines give it 12,000 horsepower to lift an overload gross weight of 209,000 pounds. Streaks across its belly are from exhaust stacks. Dummy remote-control gun turrets are outboard of the propellers.

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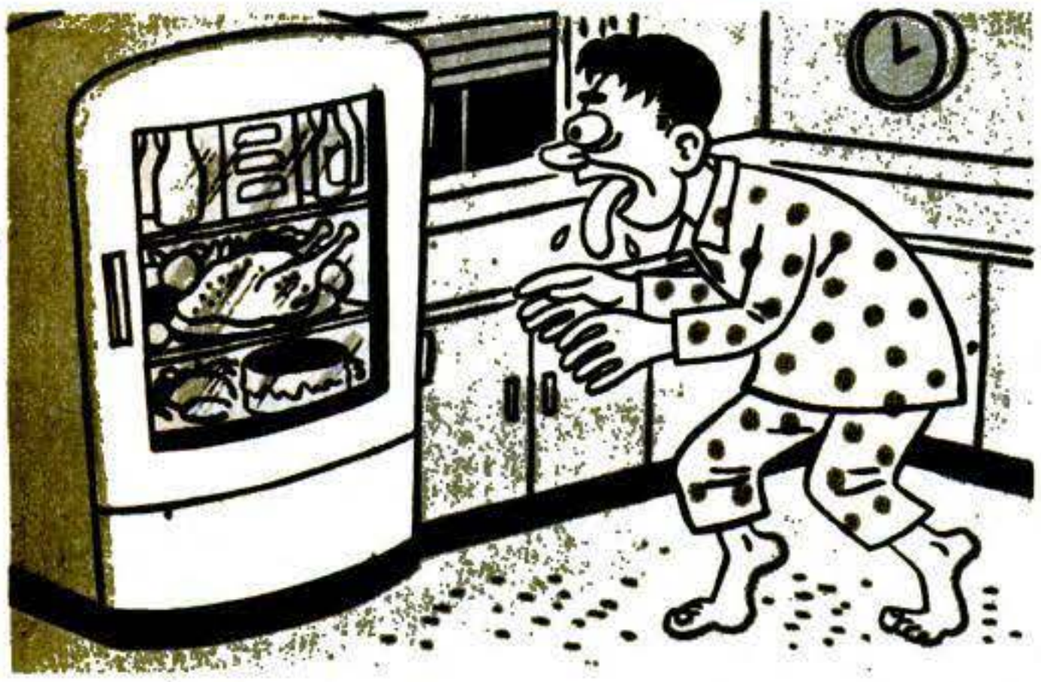
I'd like to see them make

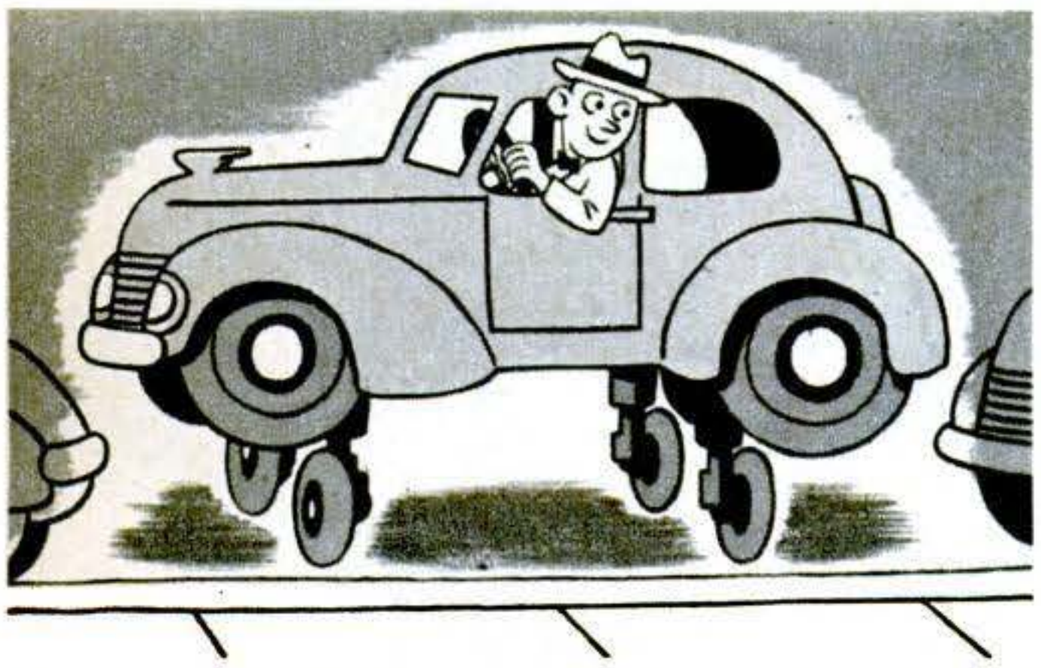
Cartoons by SYD LANDI

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay five dollars for every such suggestion that its editors decide to publish.



Open-Face Refrigerator. To end for all time the daily mystery of what's in the larder, Don Calvin, Mt. Olive, Ill., wants refrigerators with glass doors.

Autoperambulator. On hot days it would be lovely if baby's carriage were motorized and had a seat for mother, Madeline Froise, of Brooklyn, N. Y., suggests.



Parking Wheels. Extra wheels that could be lowered and used to ease a car into tight parking places would be a comfort, thinks R. A. Lane, of Toronto.

Dessert Dishes. Consider the advantages, Carl Thoresen, Rochester, N. Y., writes, of gelatin dishes that, after doing meal duty, could be eaten for dessert.

Watch-Phonograph. When there's no jukebox in sight, Robert W. Brown, of the Bronx, N. Y., thinks a watch-size phonograph and miniature records would be okay.

Still-Detector. Prowling around the mountains hunting for moonshiners is a tough job, so John Chapman, Verda, Ky., would admire a portable radar still-finder.

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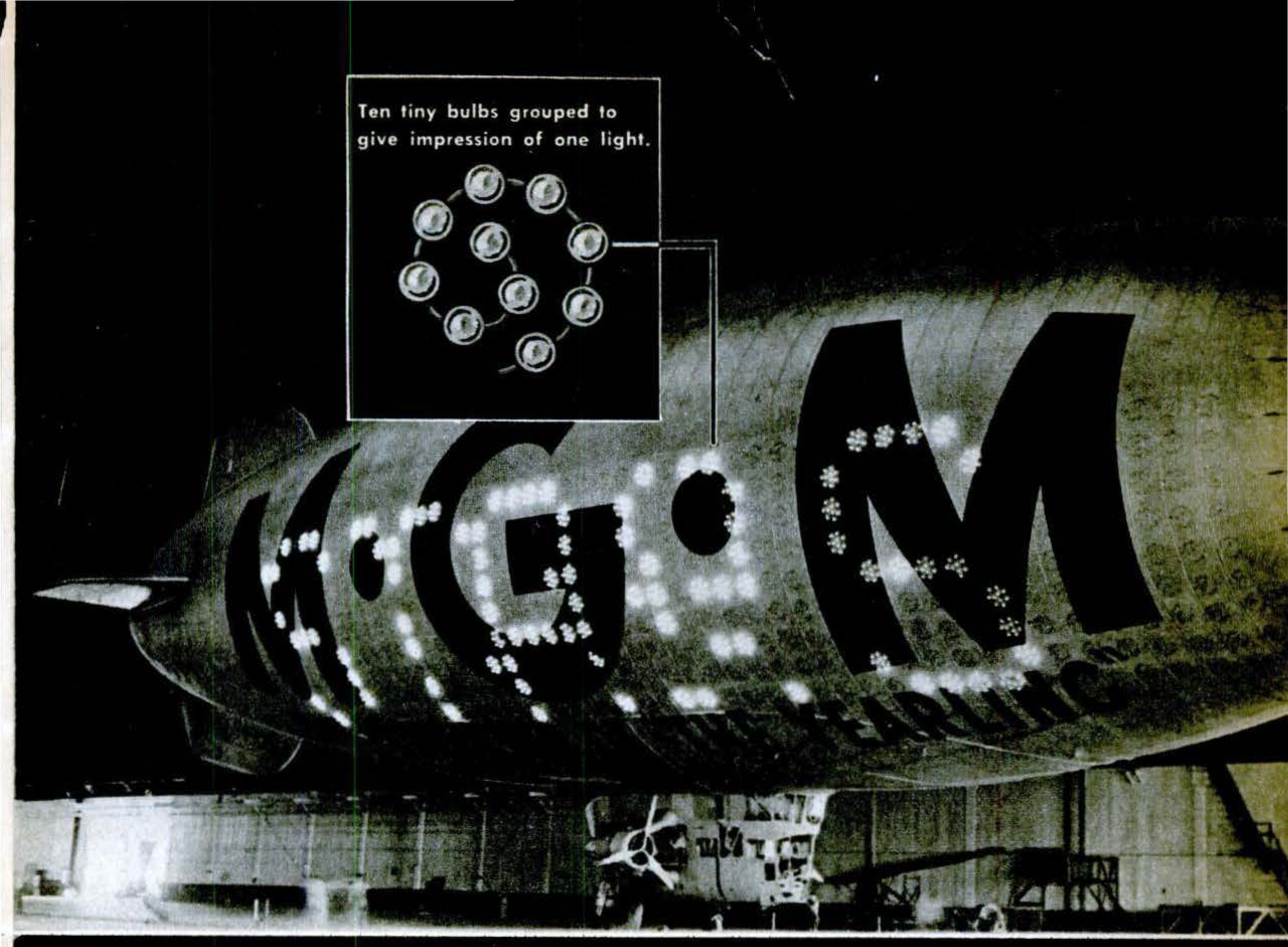

Behind the SIGNS

How the mechanical "spectaculars" work with steam, bubbles and light.

A NEW kind of electric sign is flashing its messages in the skies over New York, Philadelphia, Baltimore and other eastern cities. The "Broadway spectacular" has taken to the air.

The airborne electric display is mounted on the sides of a 265-foot dirigible that can cruise over an area of 40,000 square miles. It is the world's largest and loftiest running sign—170 feet long and 27 feet tall. Its continuous advertising messages, weather reports and spot news can be read for more than two miles and its lights are visible for five. At least 20,000,000 persons have seen it cruising overhead.

This huge spectacular is another in a long line of firsts for Douglas Leigh, the outdoor-sign king who thought up most of the moving, smoking and bubble-blowing billboards that make New York's Times Square the diamond among the crossroads of the world. Leigh thought them up and chief engineer Fred Kerwer and his assistant, Bob Leverte, worked them out.

These men consider "spectacular" a noun. It means "an oversize display with neon and lamps in unusual animations." To "neon and lamps" they could well add the word "gadget," for thingamajigs distinguish the Leigh signs.

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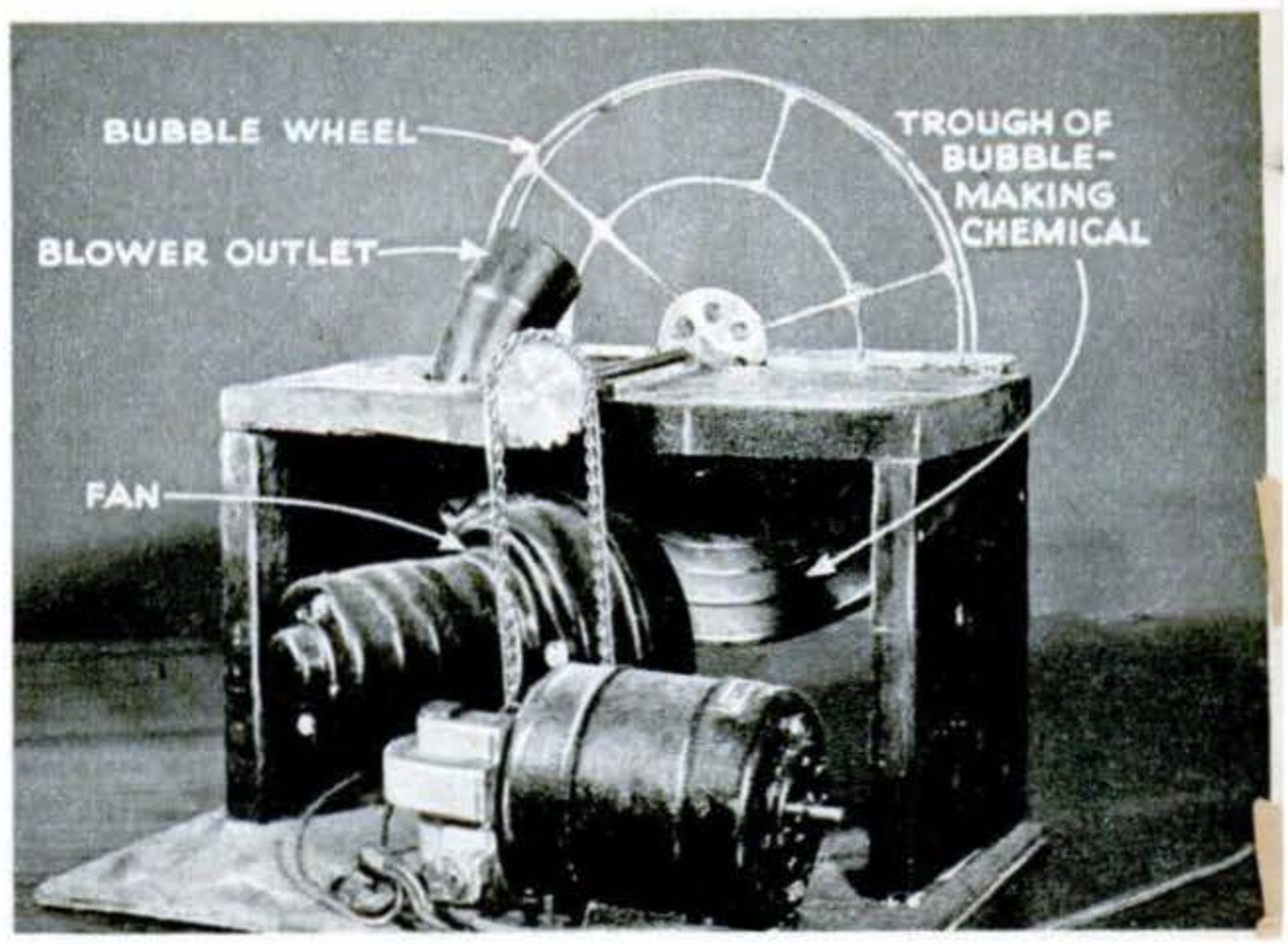
BUBBLES OVER BROADWAY. Behind this bubble-blowing sign, two-thirds of a block long, are 10 wheels (the model of one is shown at right) that, when rotated by a single electric motor, waft clouds of bubbles over Broadway. Revolving at 10 r.p.m., the wheels dip into a trough of bubble solution that forms a film between their spokes. Gentle blowers, like the one on the model, then create the tinted globules. The display uses 50 gallons of bubble solution—which acts like soap suds but isn't—each day.

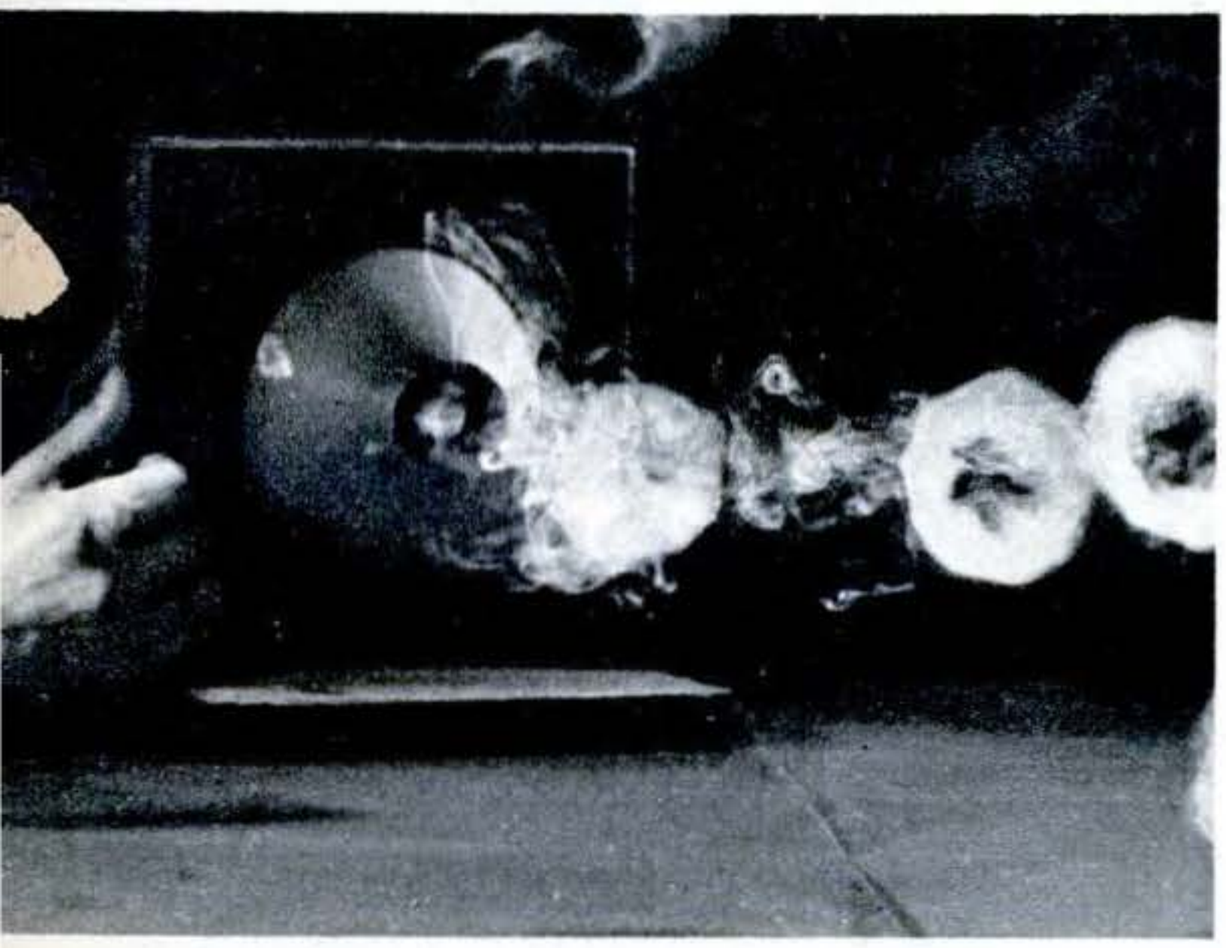


The new sky sign is an excellent example. Nearly every large city has at least one running electric sign—where words chase one another across the side of a building. But the dirigible "runner" is definitely new.

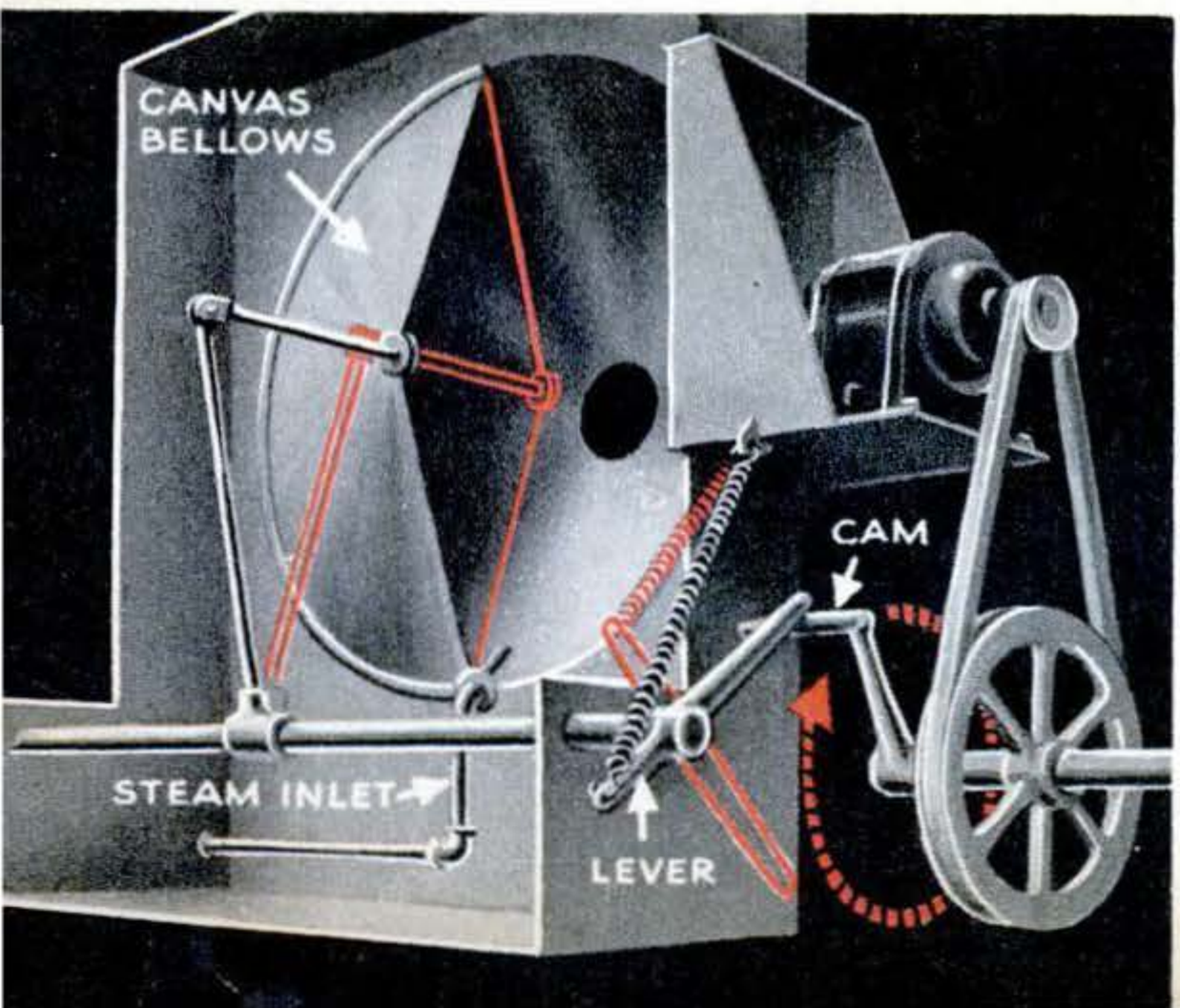
It took 26 miles of wire and 10,000 light bulbs, 5,000 on each side, to construct the dirigible sign. Enough ordinary lamps to light the display would have added too much weight, so Leigh's thinker-uppers grouped small bulbs, about the size of Christmas-tree lamps, in such a way that their light appears to come from single large bulbs. What from the ground looks like a single pinpoint of light is actually 10 small bulbs arranged in a spiral cluster 18 inches across.

The running sign is operated by a master control box in the gondola of the dirigible. A perforated tape, like a player-piano roll, threaded through a motor-driven switching mechanism, closes electrical contacts and lights the clusters in the proper combinations and sequence to form letters into words and move them across the sign. The running message can be changed simply by cutting a new tape on a typewriterlike machine.

One of Leigh's more celebrated signs was the result of the wartime blackout of Broadway. Unable to use bright lights to attract attention, he resorted to motion. The result was the painted head of a soldier with a puckered mouth that blew king-size smoke rings over Times Square. Now 18 cities have smoke-ring signs. Fifteen more will soon have them.



SMOKE SIGN. The rings that this automatic Times Square sign puffs out look like smoke, but actually they are made of steam. Behind the scenes, a cone-shaped bellows with a round opening at one end is filled with steam. It is ejected in rings when a motor-pulsated canvas diaphragm flips forward at the other end of the cone. In New York, three or four pounds of steam pressure are necessary to operate the sign during winter months, but in summer the load jumps to five or six pounds. Humidity makes the difference.



In New York and some other cities, steam for the smoke rings is piped to the sign from the city's central steam system. In communities where there is no commercial steam system, small automatic gas-fired boilers on the site supply the necessary vapor.

Steam helps also to advertise a brand of instant coffee in a Leigh billboard that shows a steaming 20-foot water bottle pouring water into a steaming six-foot cup. Steam pipes running to the rim of the cup and the opening of the bottle provide the realistic touch.

Even more ingenious than either the smoke rings or the steaming bottle and cup is the combination that uses chemicals, wheels and blowers to develop endless streams of glistening 10-inch bubbles for a new spectacular hawking a brand of soap powder. Leigh got the idea for the sign when he saw the popular soap-bubble toys

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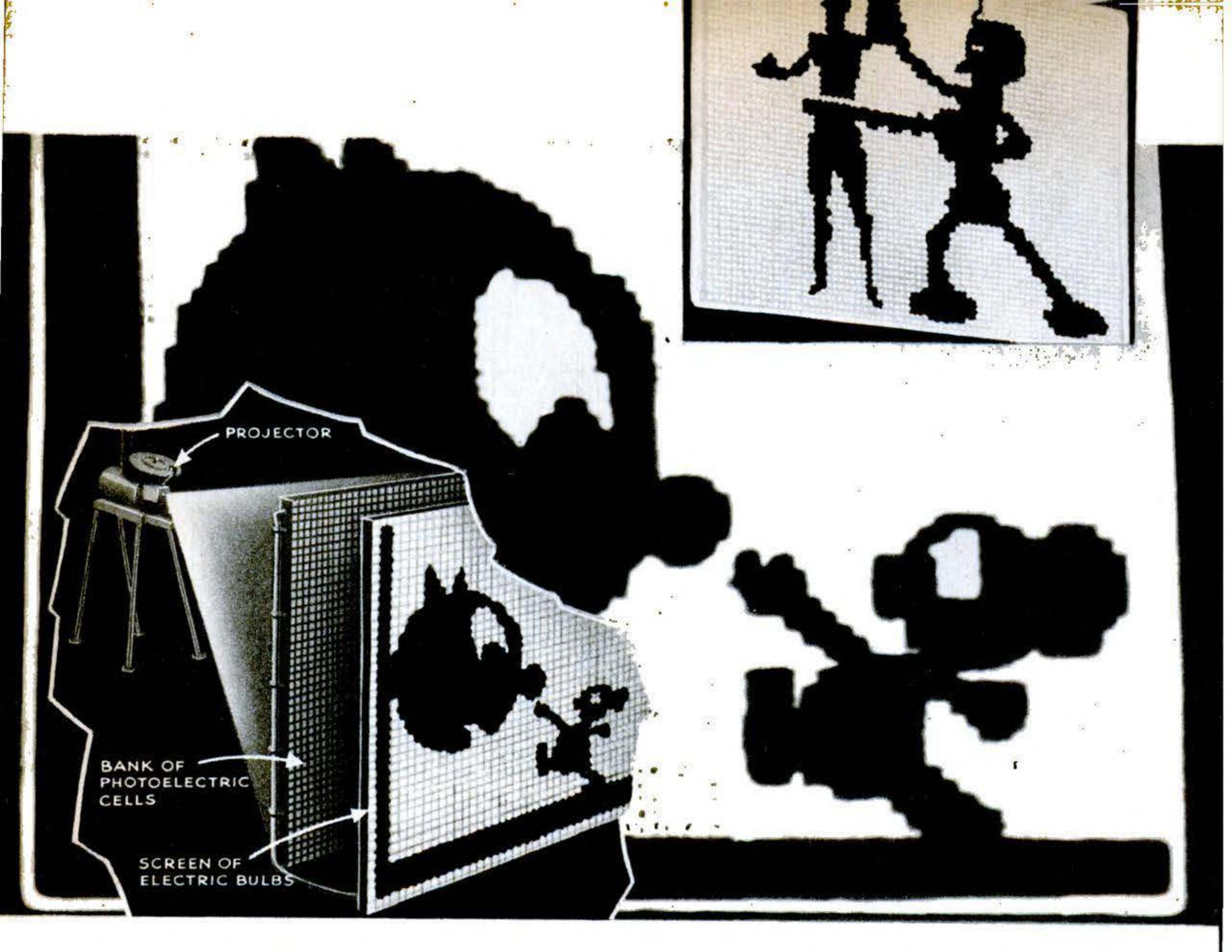

LIGHT CARTOONS. The diagram directly above shows how animated cartoons are projected in lights on one of Leigh's Times Square spectaculars. Films in black and white are projected on a bank of 4,104 photoelectric cells behind the face of the sign. Light passing through the transparent parts of the film energizes the cells, which in turn light matching bulbs on the sign's screen. Real dancers sometimes replace the film, dancing behind the face of the sign to produce living pantomime (inset). The free show, which is a real Broadway hit, is changed at intervals.

in a five-and-ten-cent store. A few months later Kerwer and Leverte had a working model that automatically blew 1,000 bubbles a minute. The model was soon incorporated in a sign on Broadway.

Bubbles are also featured in a new Broadway diorama, or three-dimensional sign. To advertise ginger ale and club soda, two eight-foot-tall plastic highball glasses effervesce in front of a continually rising backdrop of large bubbles. Compressed air piped into the bottoms of the glasses provides the bubbling effect, while hundreds of 20-inch hollow glass globes mounted on endless motor-driven belts of invisible steel wire create the rising background of bubbles.

One of Leigh's—and the public's—pets is a sign that features animated cartoons. This type of display has amused crowds and stopped traffic in New York, Boston and a number of other cities for eight years.

In developing a new sign, Leigh has a standard routine. Once he is satisfied as to the general idea, he turns the project over to his engineers. They then evolve a working model of the display. After this follows a period of tinkering by the team of Leigh, Kerwer and Leverte. The working models are like what might come out of any basement workshop—they are built of ingenuity and odds and ends. For instance, a tin can of the type used to store amateur motion-picture film is cut in half and soldered to form the trough in the prototype of the bubble-making machine. Kerwer and Leverte are as handy with soldering iron and a screwdriver as they are in designing the world's biggest and brightest spectaculars. For example, before the dirigible display was sent into the air, their office in New York's Radio City was the

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WHAT'S THE WEATHER? As the weather predictions go, so goes this 4,000-square-foot spectacular at New York's Columbus Circle. To show the temperature, a thermometer on the sign moves a hand electrically across a figured dial. At the same time, words and pictures flash the weather forecast. If the prediction is "fair," for instance, the word *fair* appears on the face of the sign, and a neon sun, replete with rays, lights up to emphasize the prophecy. The prediction feature of the sign is operated more than a dozen blocks away by remote control. The girl in the inset is shown at the control box bringing a forecast right up to the minute.

scene of working tests of the 10-bulb clusters of miniature lights that were used to illuminate the flying billboard—the first of three, incidentally, that are scheduled to take to the air.

If the sign is to be principally a lighted display, the design is carefully drawn and painted in colored fluorescent paints on black drawing board so that when it is viewed in a darkened room under the light of an ultraviolet lamp it gives the effects of tubes of glowing neon and brilliantly colored lights. Frequently the actual working models are dressed up and decorated with fluorescent colors to give a prospective client a moving three-dimensional idea of what the completed sign will look like.

Leigh's future list of spectaculars includes many novelties. The most ambitious is an advertisement for oranges in which a giant helium-filled balloon, the color and shape of an orange, will float in the air and drip juice into a 12-story-tall plastic glass. In another, basketball-size kernels of breakfast food will crackle and pop up from a 20-foot bowl. Right now, Leigh has his eye on the Rock of Gibraltar as a possible site for an advertisement for an insurance company that uses Gibraltar as part of its slogan. He hasn't yet revealed what kind of mechanical gimmick he'll use to animate the Rock. END

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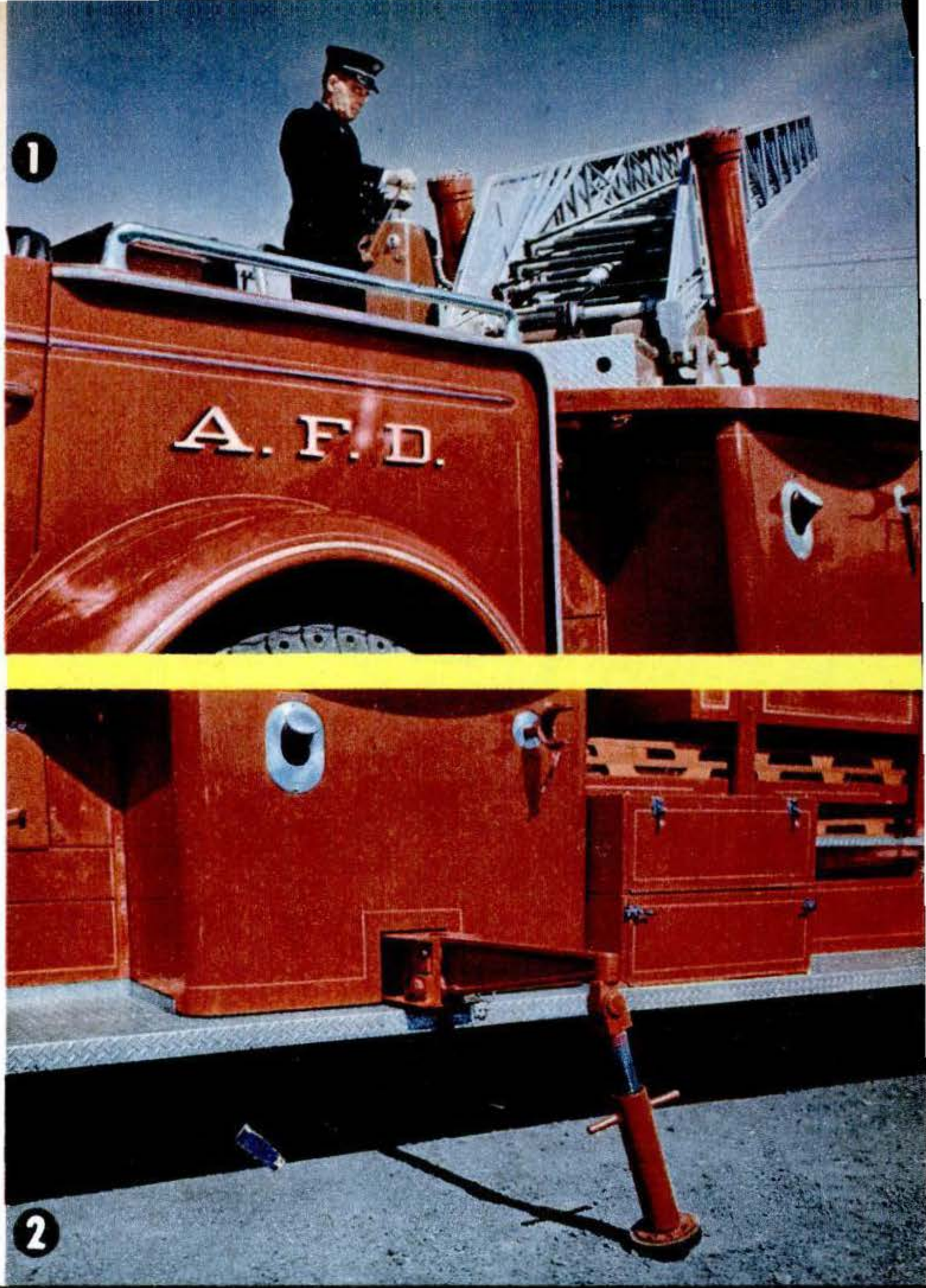
1. New American-LaFrance-Foamite aerial truck illustrates compact power of postwar fire engines (See "Here Come the New Fire Engines," p. 66). Unlike old-style articulated trucks, it is a single unit and needs no rear-wheel tillerman. Steel extension ladder is 100 feet long—15 feet more than prewar type—and holds eight men when it is supported at the top.

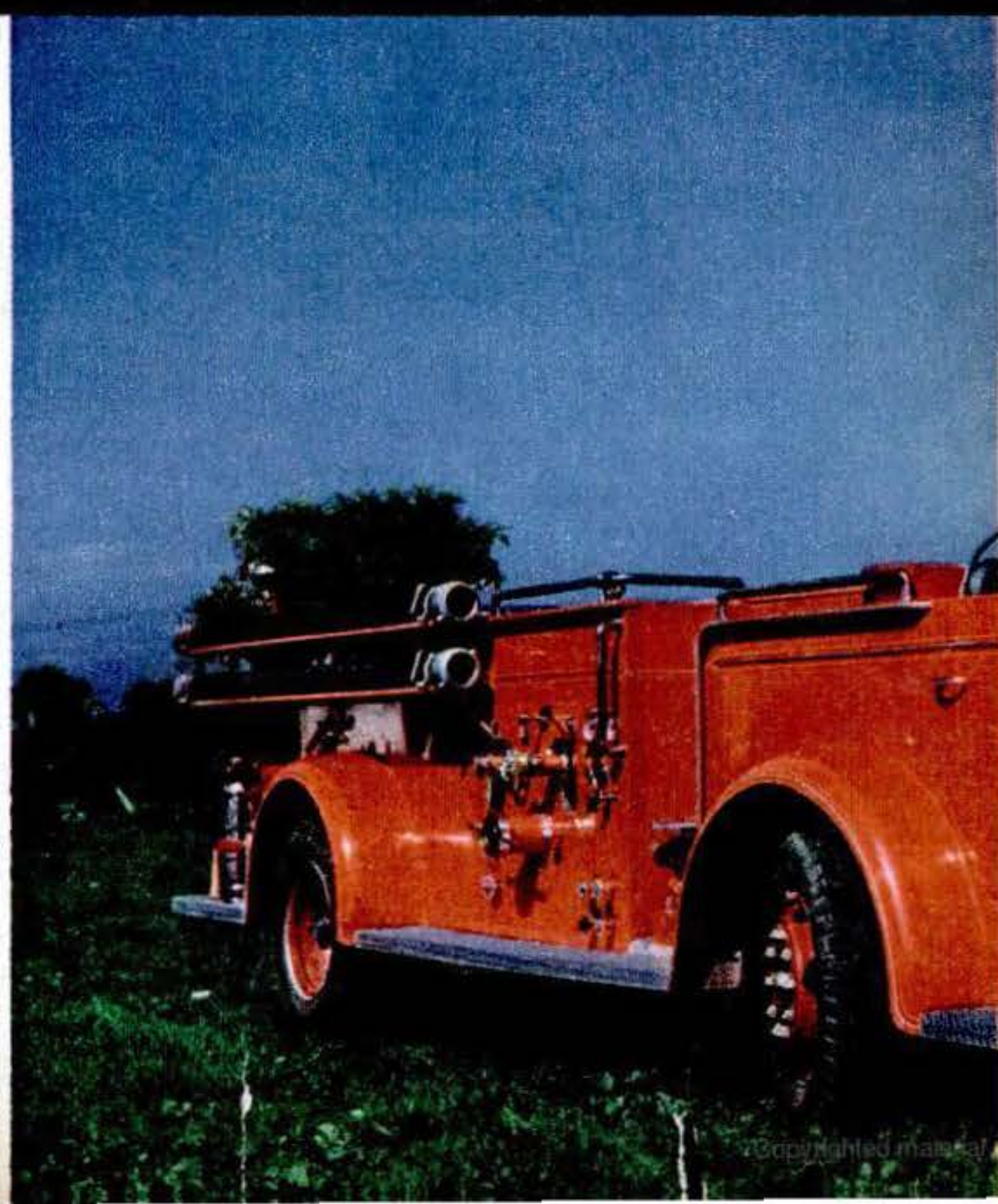
2. Built-in jacks on sides of aerial truck have to be set to brace it whenever the ladder is extended out to the side. Truck sometimes has to be moved in a hurry—as when a building wall collapses or flames spread suddenly—so jacks are hinged to let truck roll off them in an emergency. When not in use, the jacks swing upward and fasten to truck body.

3. New aerial truck's shortened wheelbase—220 inches—permits greater speed on way to fires because it can take corners faster. New fire engines, including pumpers, can be turned around in a 50-foot-wide street. Driver's seat is farther forward for improved visibility. Old trucks gave only a five-degree angle of vision over hood; new ones give 21 degrees.

PSM photos by W. W. MORRIS



'ATTLEWAGONS for Today's Fire Fighters

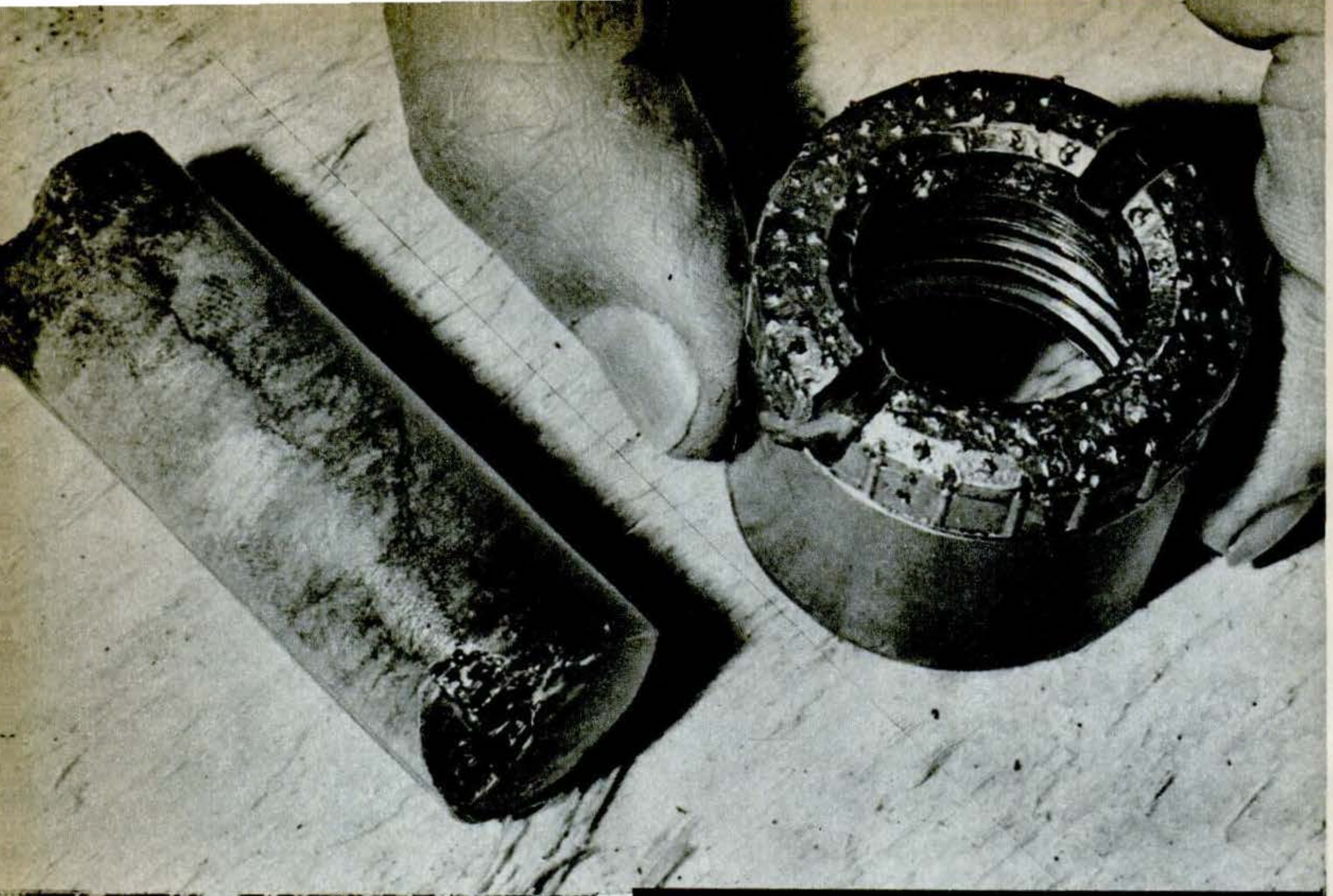


4. Every pumper is tested before it leaves the factory. This closed-cab model, with a 240-horsepower engine, throws 1,250 gallons of water a minute. In tests, water is drawn from a cistern, routed through pumper and returned to cistern. Nozzles are clamped firmly to wooden frame to withstand water pressure, which is indicated by turbulence in cistern.

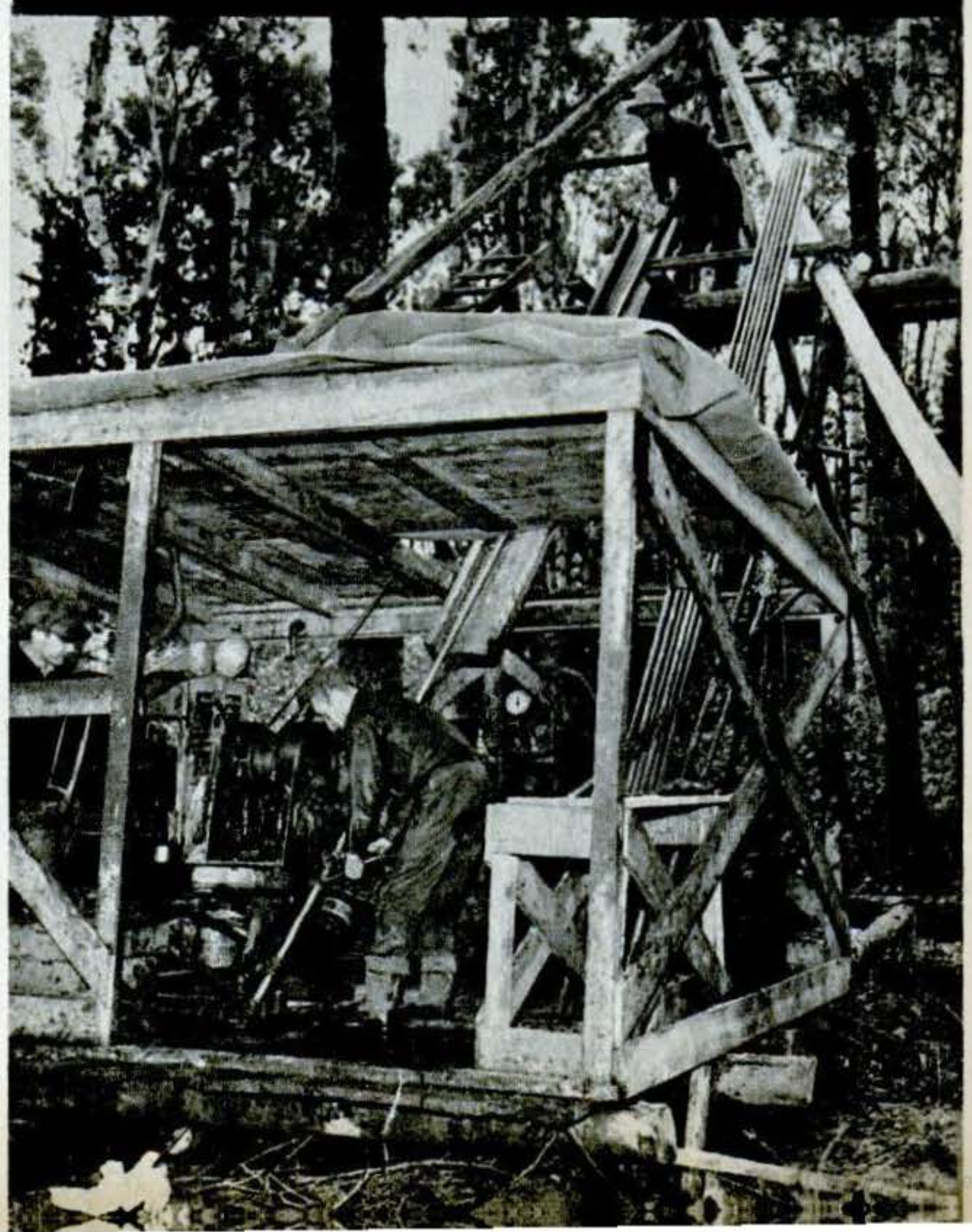
5. A fireman removes cover cap on pump inlet. Size of suction hose indicates a pumper's capacity: 4½-inch hose for 750 gallons a minute, 6½-inch for 1,000 gallons or more. With hose hooked up, the discharge gates opened, throttle set, and governor turned on, pumper is ready for work.

6. This open-cab pumper races to fires at 75 m.p.h. It is 25¼ feet long, has a 150-inch wheelbase and handles 750 gallons a minute. Firemen ride on fully enclosed seats instead of old-style running boards and tail step, protecting crew in case of accident.

7. Front end of low-slung pumper contains towing eyes, red parking lights, headlights, two 140,000-candlepower searchlights, combination siren and flashing warning light, and cord-operated bell. Racks on far side hold ladders.

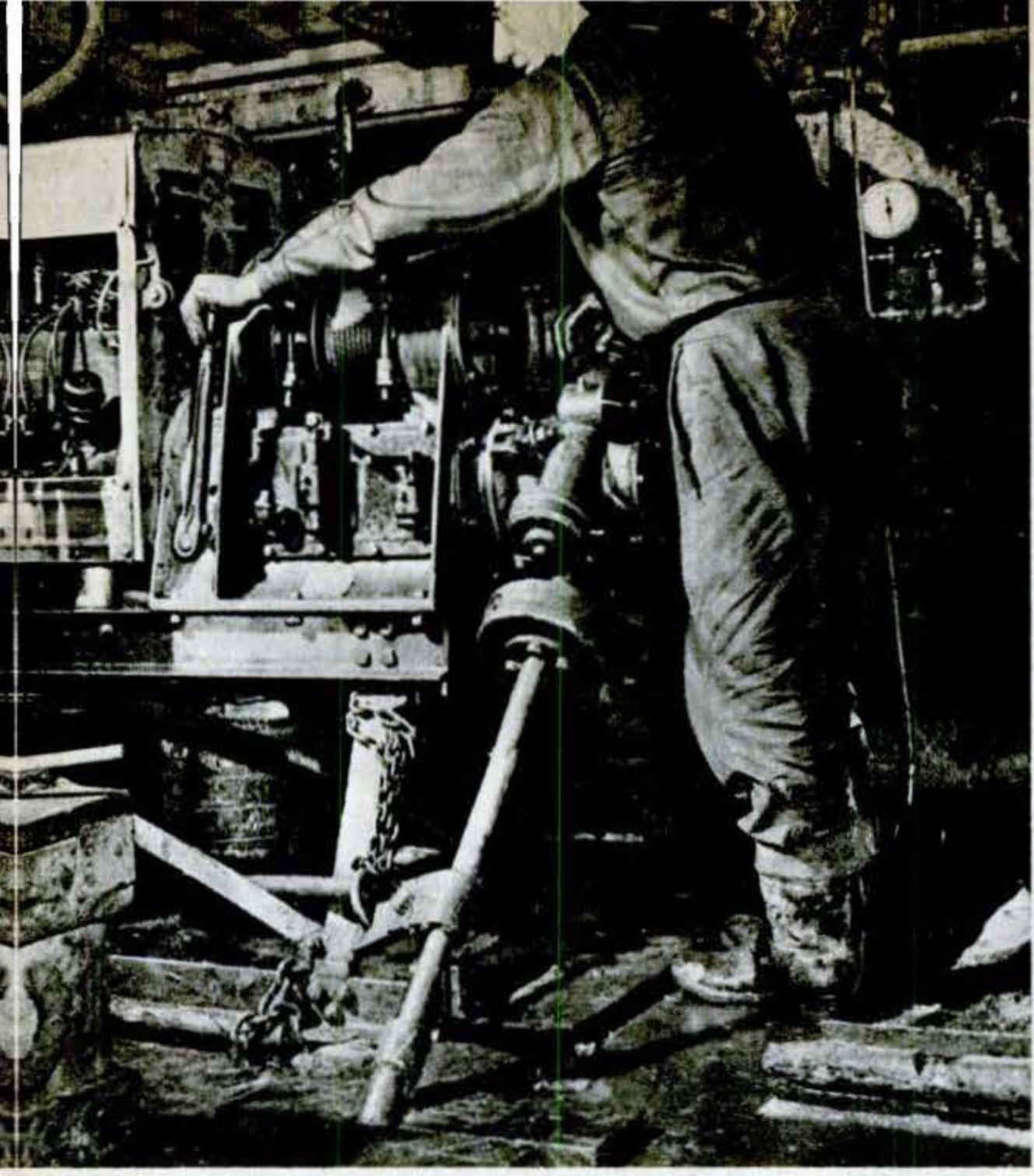


DIAMONDS



ABOVE: This light, portable diamond drill is the sort flown in to inaccessible Ontario districts and used to drill holes less than 150 feet in depth.

RIGHT: A drill outfit "pulls a core." Cores are ¾-inch in diameter. A lean-to protects the crew from weather, for drilling is a year-around job.



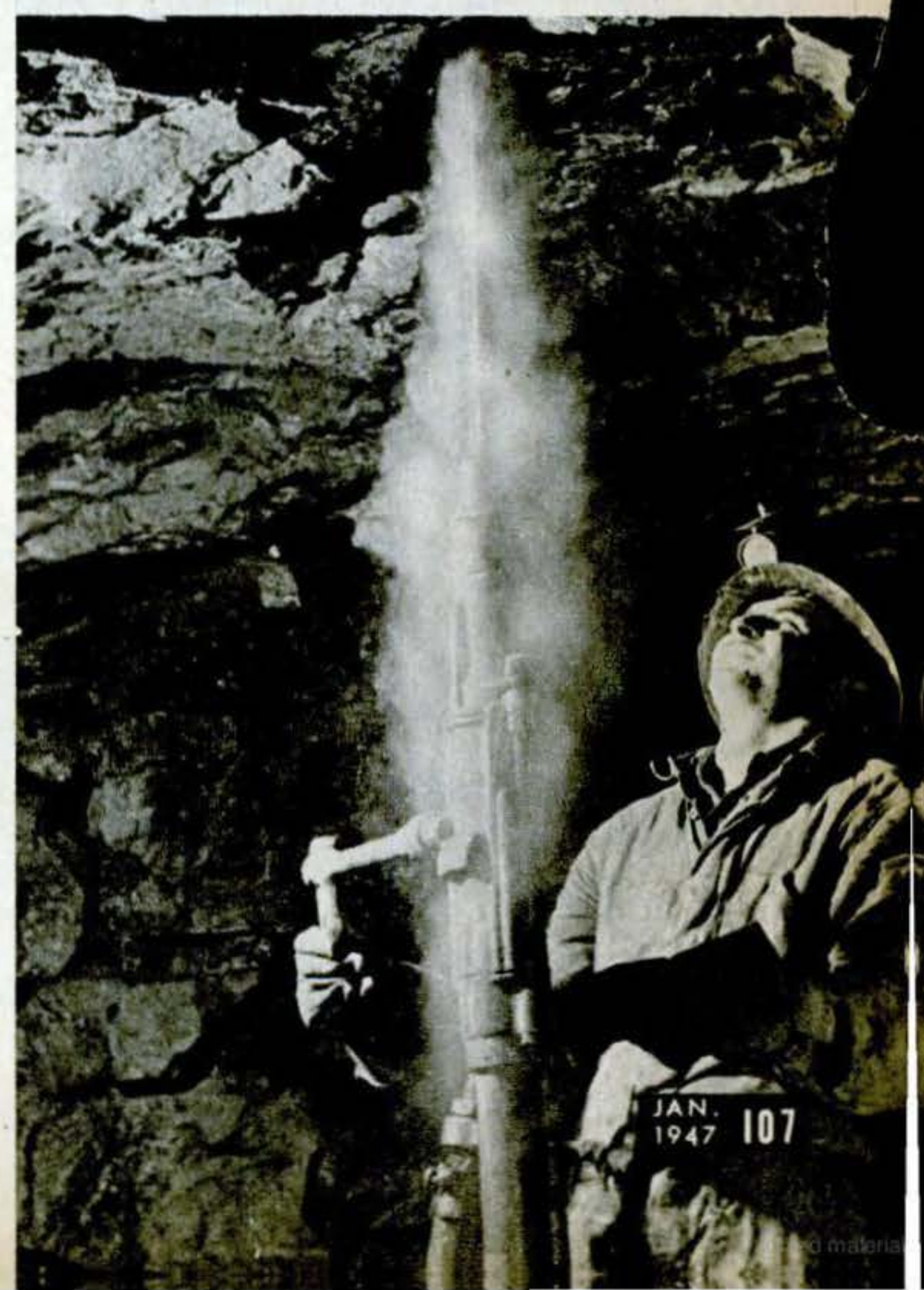
ABOVE: This mechanism drives a drill as deep as 1,500 feet into rock. It's costly but necessary.

GOLD is where the diamond drill finds it. Guided by prospectors, geological maps, and detection apparatus, the drills probe deep in likely areas. The photos on these pages were taken in Canada's Red Lake region.

Dig for GOLD

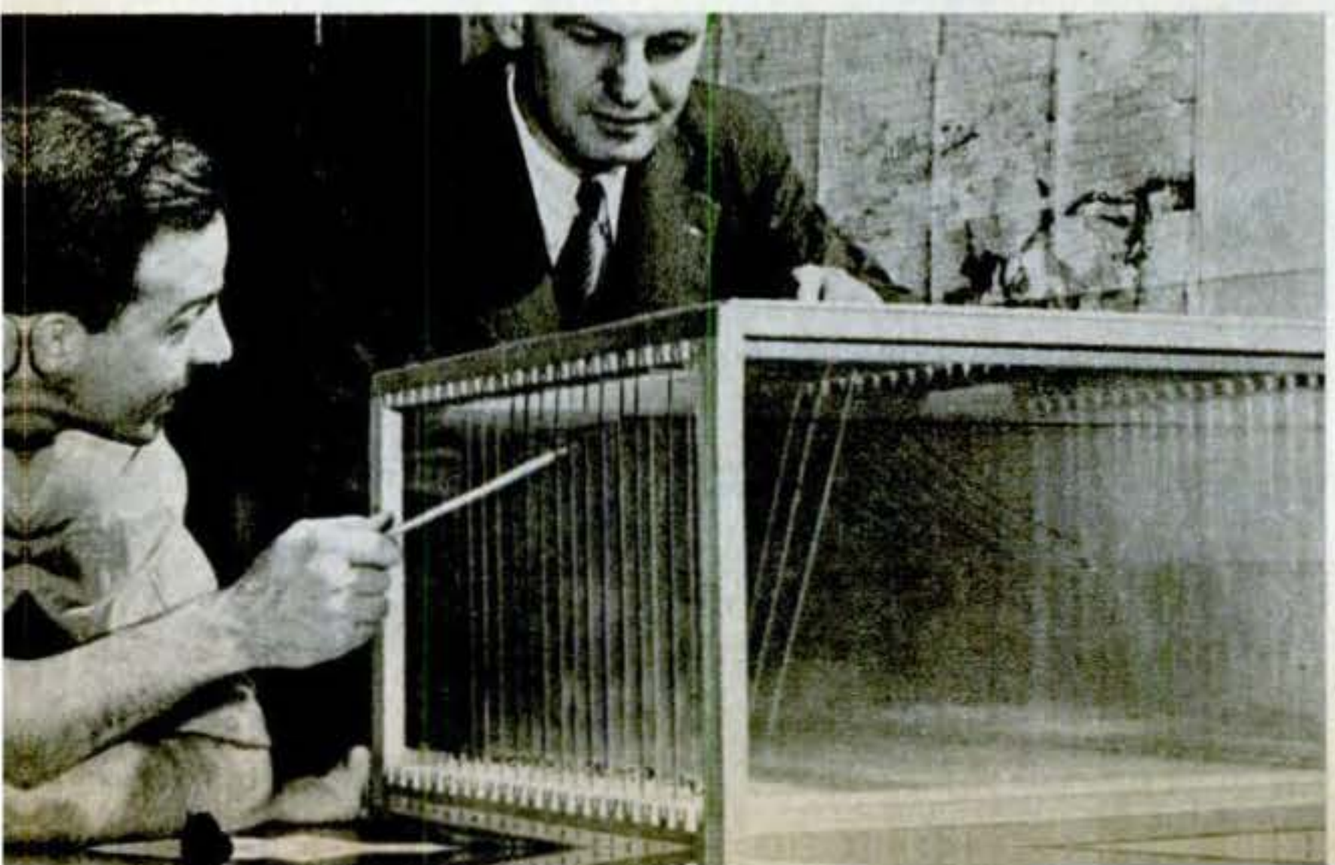
RIGHT: Here a stoping drill loosens ore 800 feet below the surface in the Agaunico mine, Cobalt, Ont. This mine was discovered with a diamond drill.

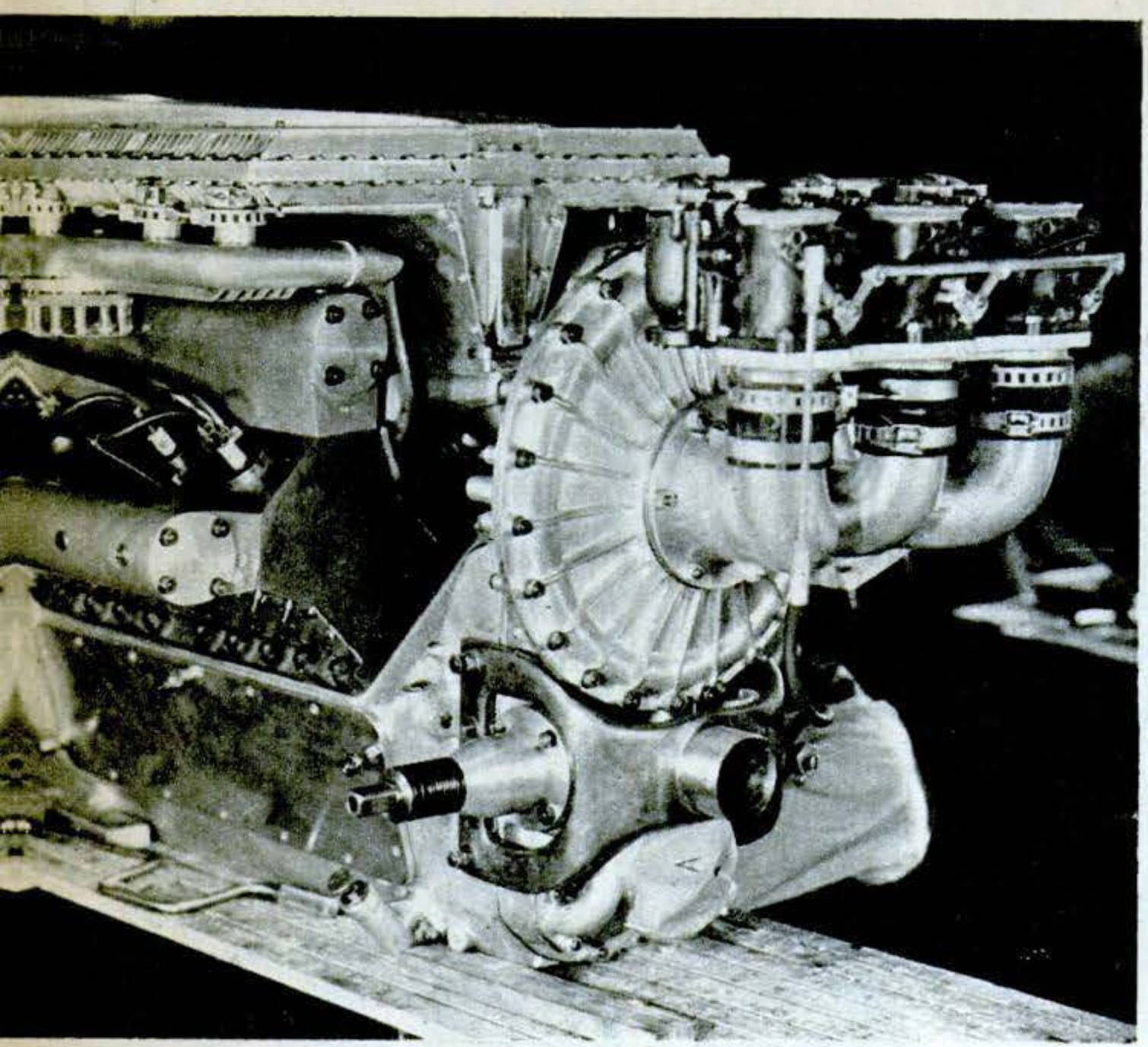
BELOW: Glass models show position and angle of drill paths. As many as 300 test holes are sunk on a claim before mining shafts are driven.

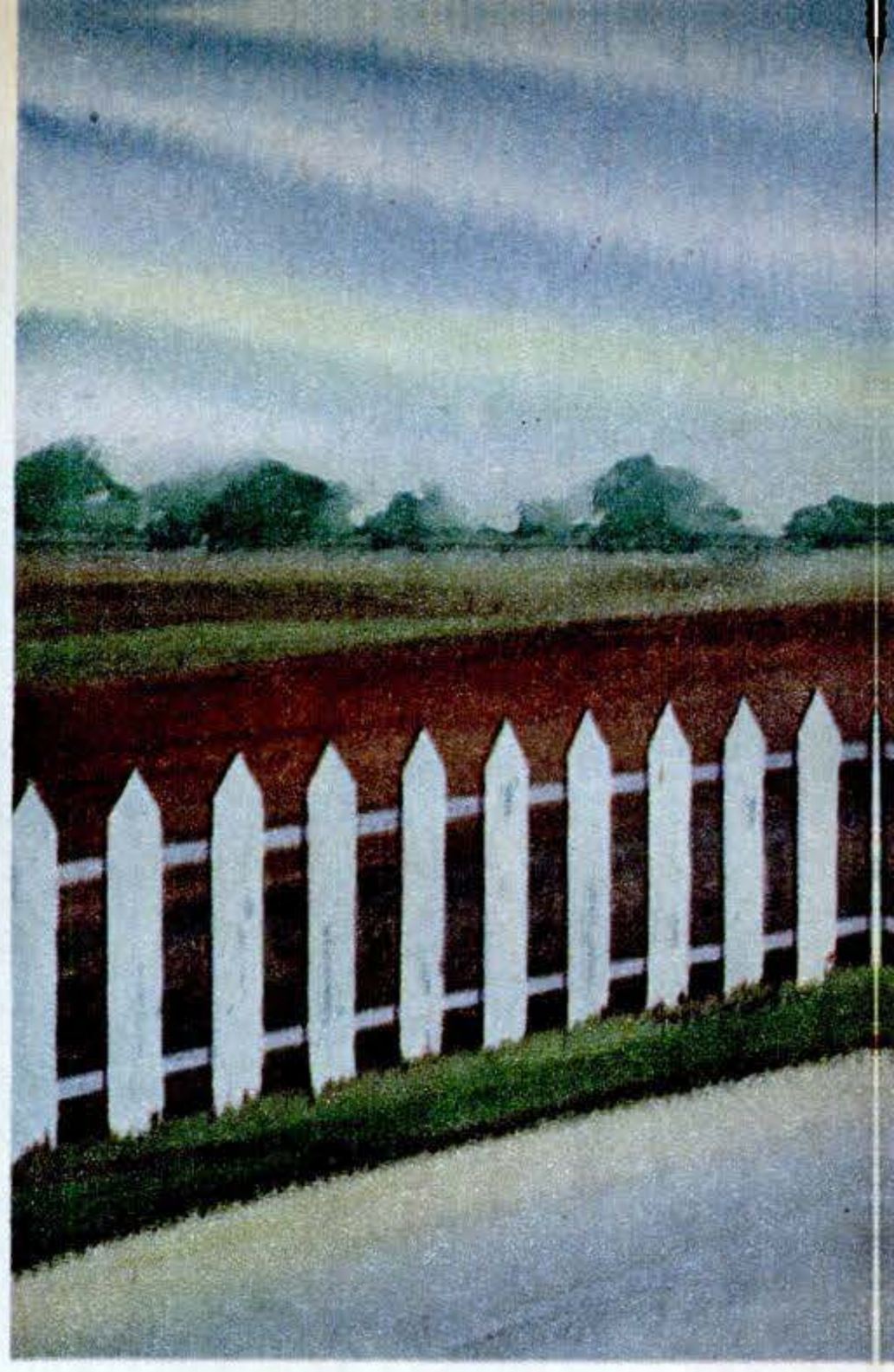


ABOVE: Core is tapped out of pipe, into box. It holds the secret of strike or dud. Half the core goes to assayer, who follows the drillers.

BELOW: An assayer in his tent analyzes core to see if claim that was tested is worth mining.

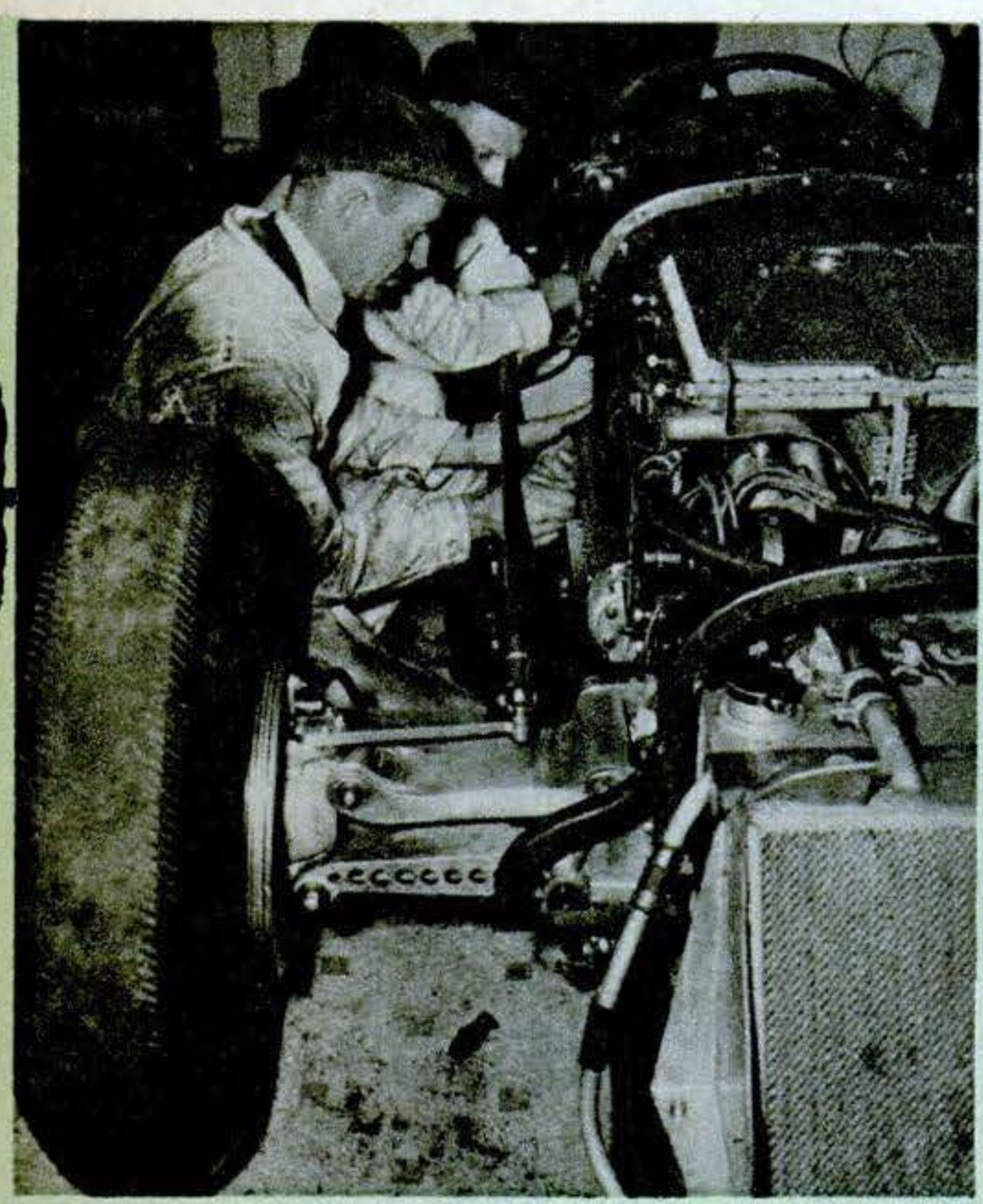




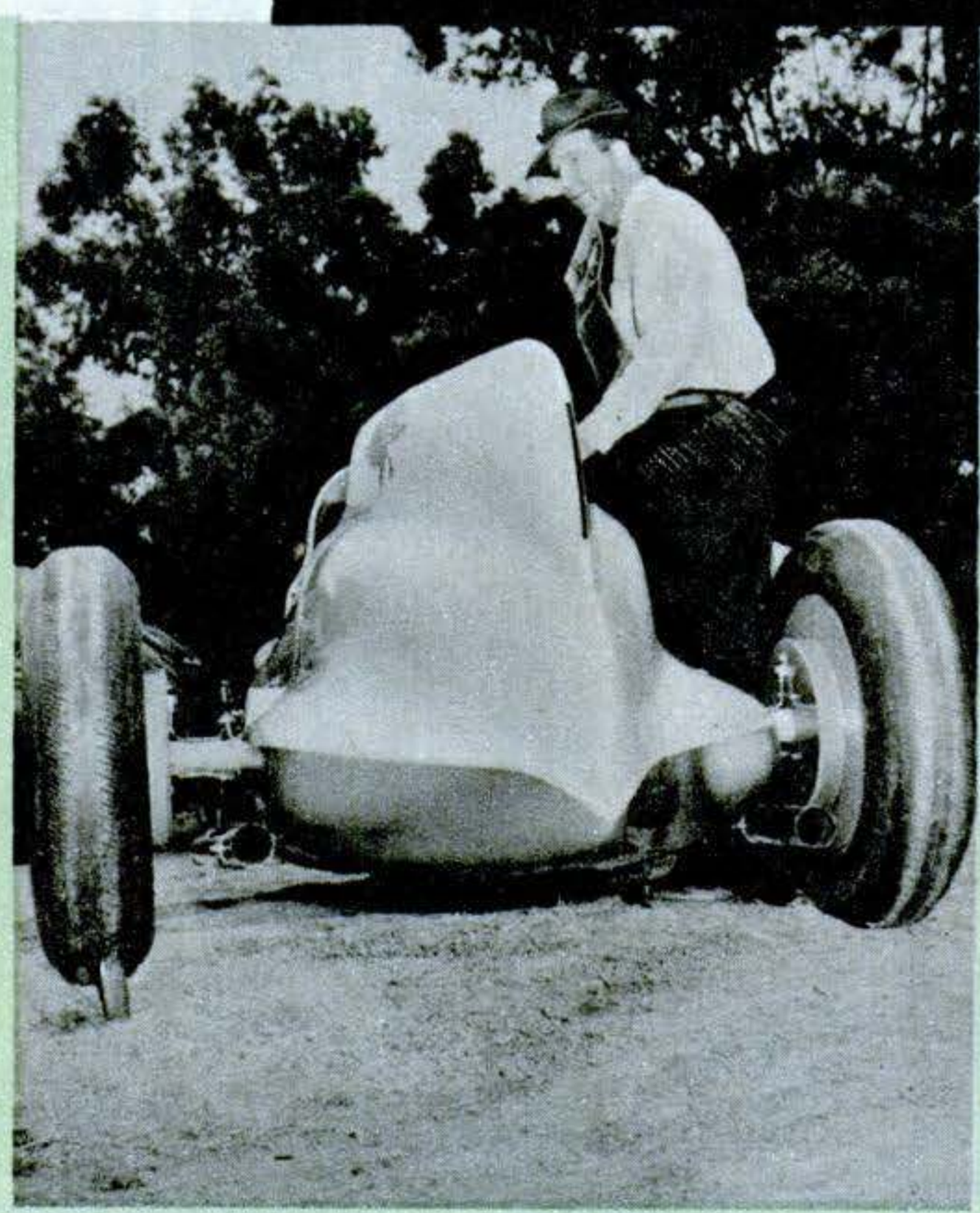


Racer's engine burns alcohol, produces 550 horsepower at 8,500 r.p.m. to drive car at 260 m.p.h. Three Winfield carburetors feed 38,000-r.p.m. supercharger; aftercooler, on top of block, prevents pre-ignition. Compression ratio is 24 to one.

JENKINS



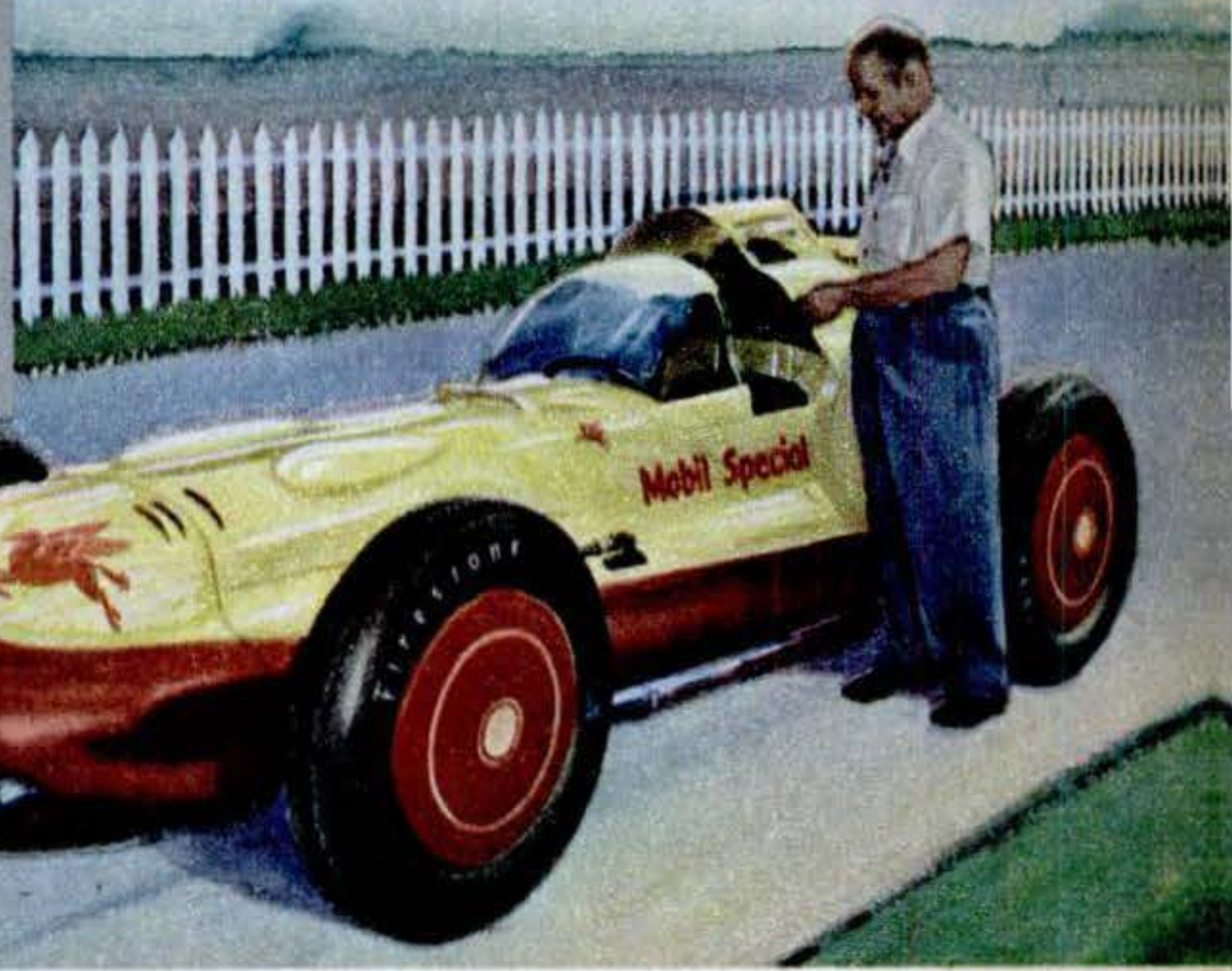
Front-wheel drive helps hold the "Mobil Special" on its course. Front wheels are individually sprung, with torsion bars replacing ordinary leaf springs. Tires' rubber tread is only 3/32-inch thick.



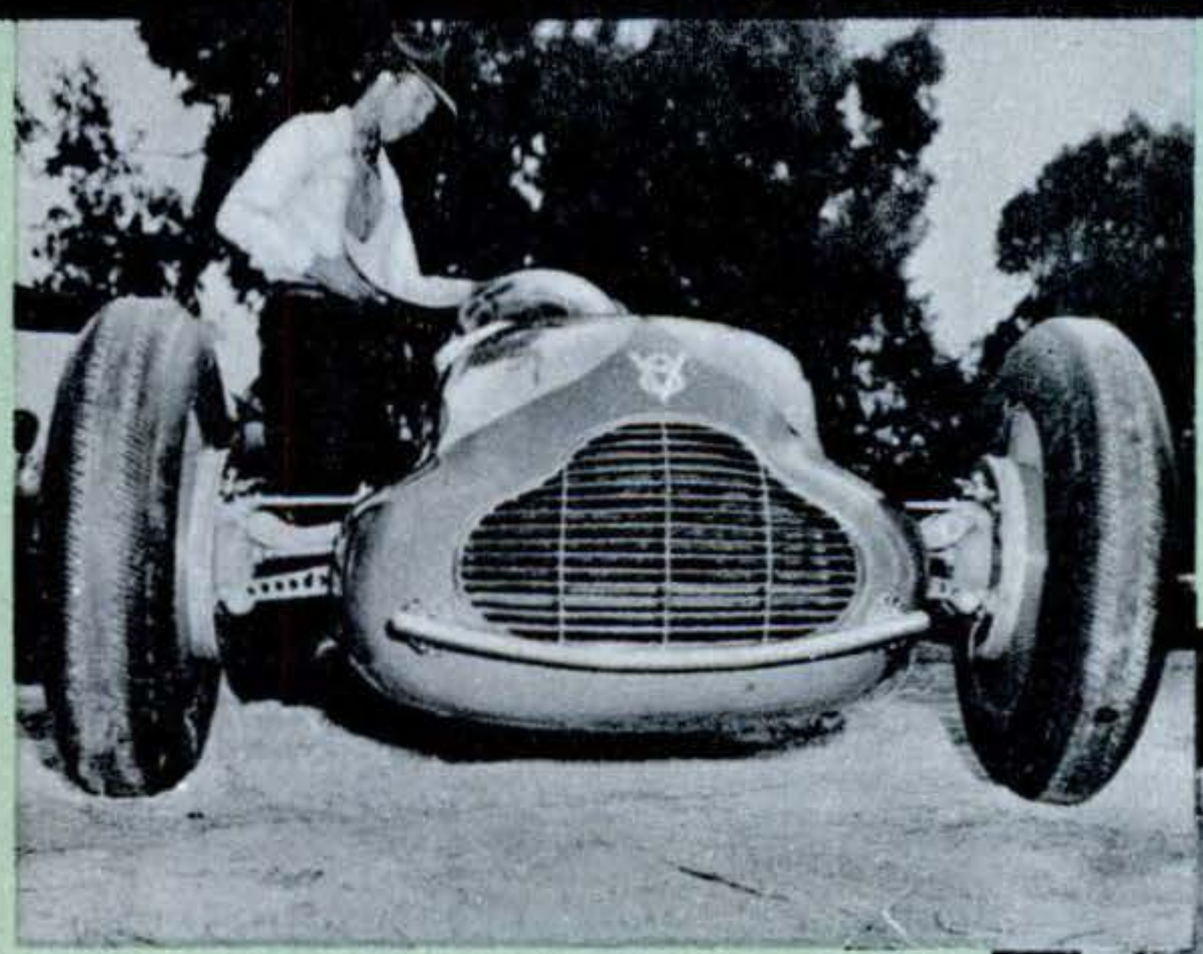
Bud Winfield, who built the engine, examines completed car. Tail, narrowing to a thin line, is designed to stabilize machine while it races over a 10-mile circle on the hard-packed natural track.

Copyrighted material

With this 1,900-pound package of power, Ab Jenkins hopes to cover 4,000 miles or more in 24-hour runs on Bonneville salt flats, Utah. Out to crack all his former speed records for distances of 500 miles and up, the veteran driver is shown here beside his new racer and (inset) in its tiny cockpit, with plastic canopy and simplified instrument panel.

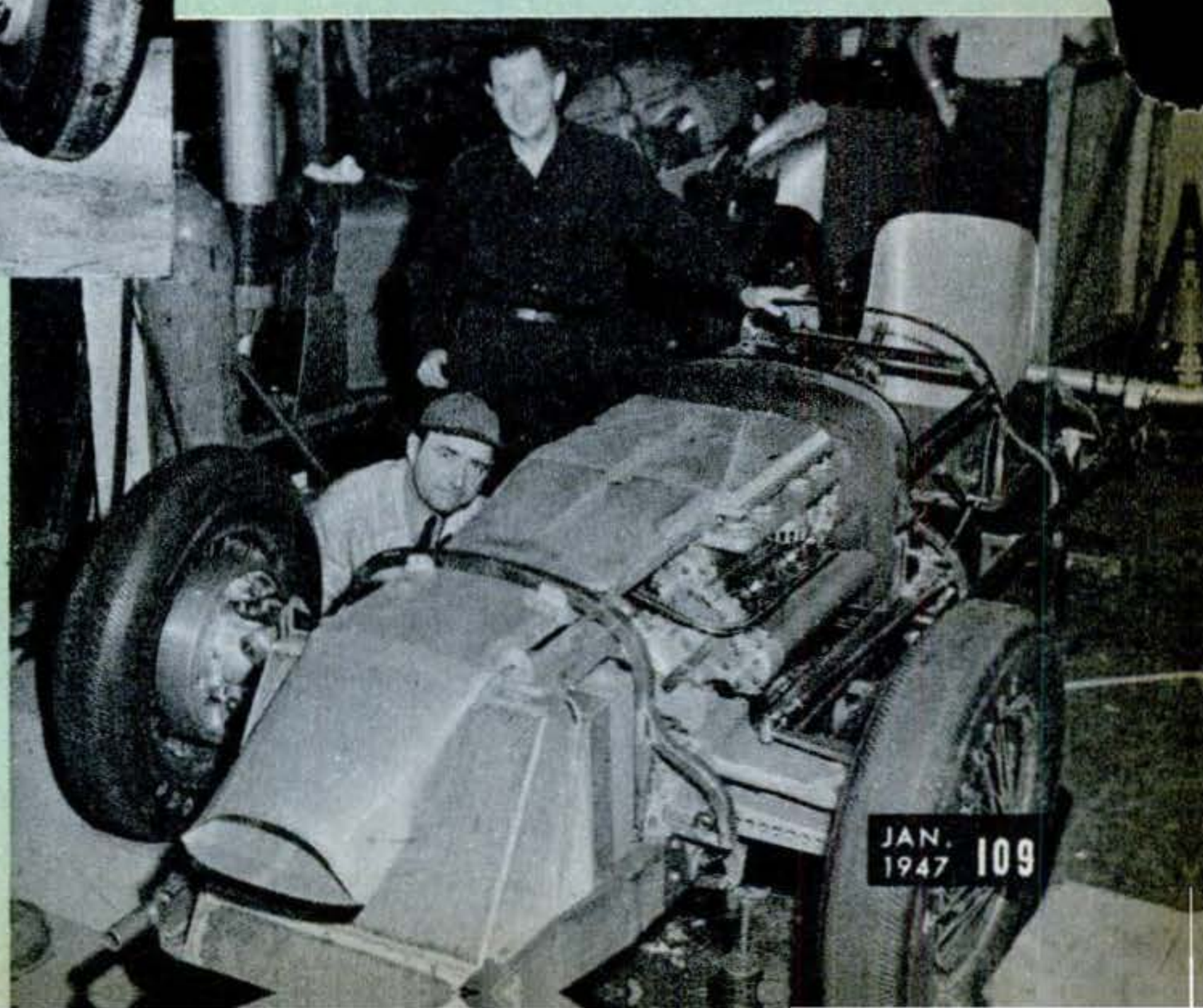


TUNES NEW SPEED MACHINE



Front view of racer, above, emphasizes its ground-hugging design. It is only 36 inches high, including canopy. Jenkins's previous car —the "Mormon Meteor," which did 3,868.14 miles in 24 hours—was 2½ times as large, weighing 4,800 pounds. Jenkins has two relief drivers for tests: his son, Marv, and Ralph Hepburn, who used this chassis with a different engine at Indianapolis in the Labor Day races.

Below is car's completed chassis, ready for the body. Air scoop extends out over radiator and oil cooler. The oil used is standard S.A.E. #50, instead of the castor oil that usually lubricates high-speed power plants. The 470-pound, V-8 engine has sterling-silver connecting-rod bearings with thermocouples at important points; a dashboard selector switch permits driver to read temperatures instantly. Water injection, up to 20 percent, is employed for greater power.

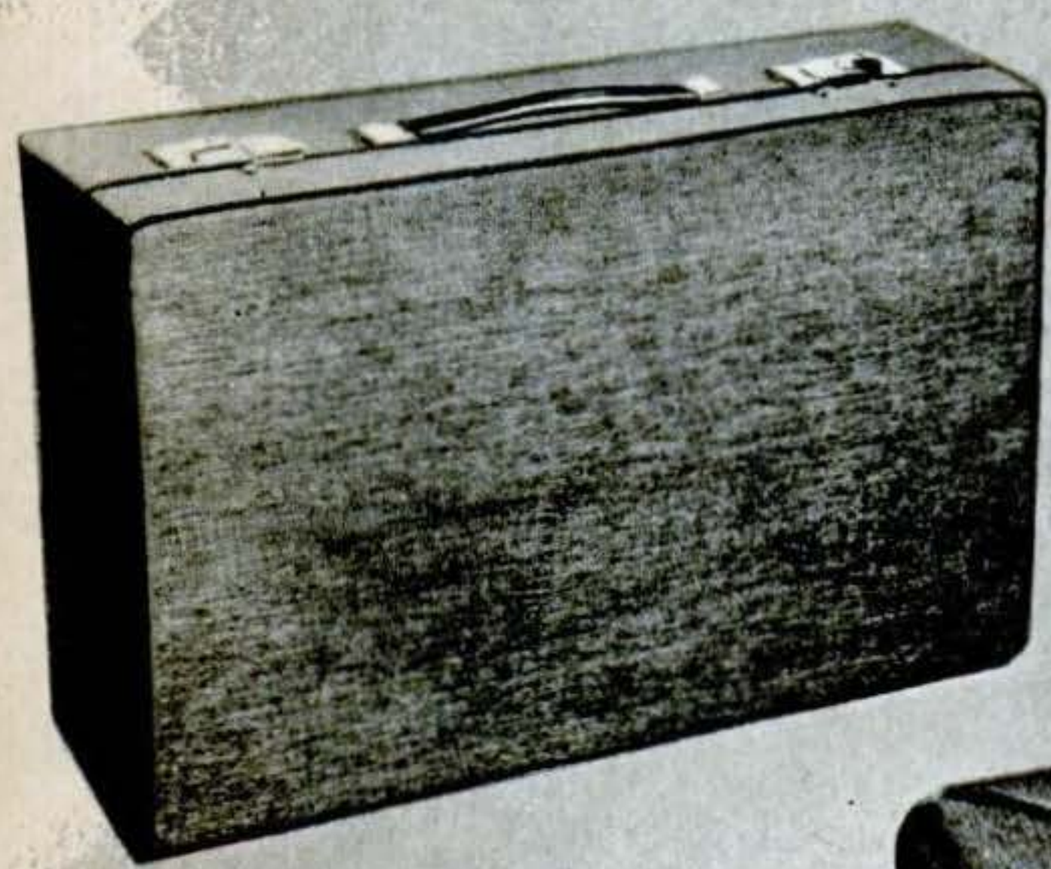


Shelving its dreary "utility" products of the last seven years, Great Britain is going to the other extreme to attract foreign customers. The large, flat, rectangular radio at left, claimed to provide superior sound reproduction, is typical of the postwar products recently displayed in London at the "Britain Can Make It" Exhibition.

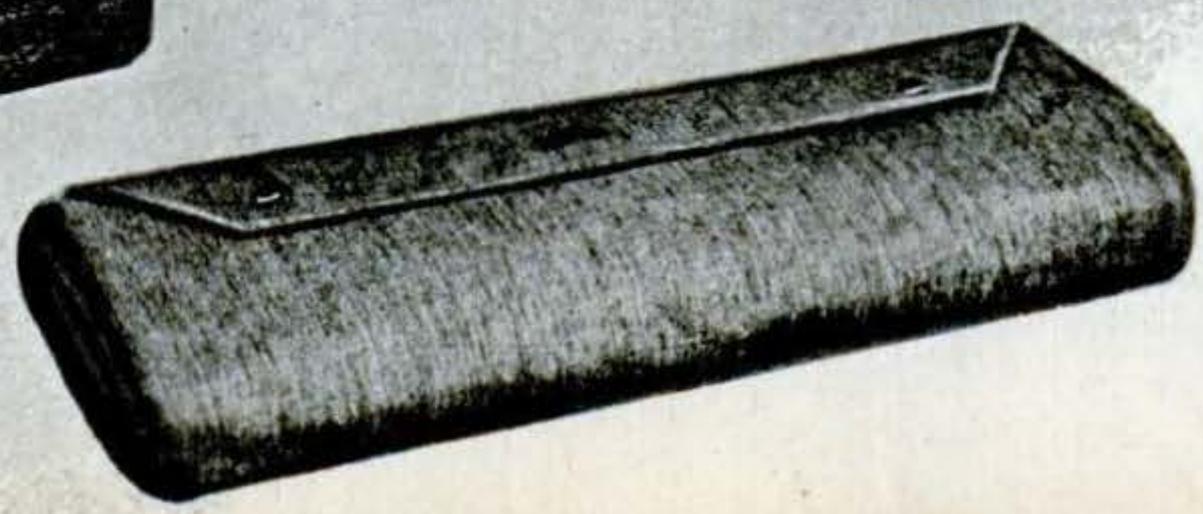
Because a plug blows out and releases steam when the pressure grows too great, water cannot boil over in the double-plated copper kettle at right. The three-pint kettle, fashioned of chromiun on copper, also has a safety device that keeps it from boiling dry when the cook's away.

BRITAIN Streamlines the Goods

Built with an extraordinarily long spout that breaks the force of water sprinkled on delicate seedlings and plants, the watering can at right impressed flower-growing Britons. The sprinkler has a handle shaped for easy carrying and filling. A detachable nozzle with a serrated edge can be placed in the spout to give a fine spray.



When the suitcase at left is not being used, it can be collapsed, placed in the matching canvas cover below and stowed away in a minimum of space. The bag can be restored to usable shape by springing it out. Small clips inside fasten it rigidly. The case's handle is a spring covered with leather. Within, it is lined with moire and has large pockets. Most articles at the exhibit were functional.



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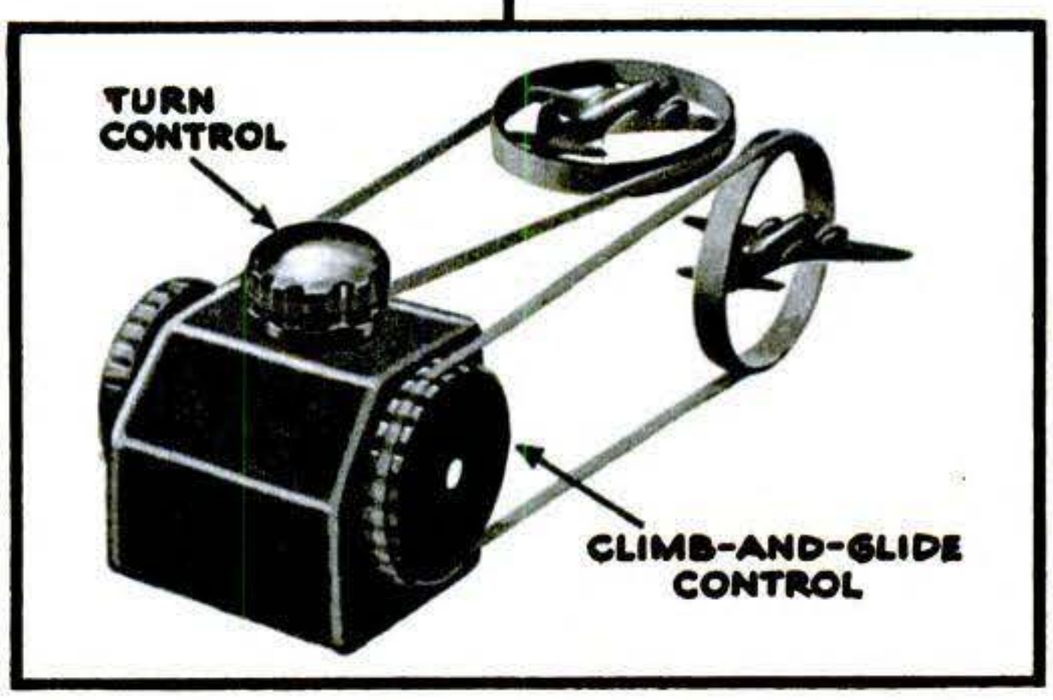
New Jobs for "GEORGE"



Top photo shows "George" installed in plane cockpit. The pilot has his hand on the pitch control wheel of the pedestal controller. To glide, he pushes the top of the wheel forward; to climb, he rolls it back. Co-pilot uses twin wheel on other side of pedestal. Monitor indicators in between show signal being sent to rudder, ailerons and elevators, revealing trim of plane while in automatic flight. Inset is close-up of pedestal controller. Knob on top is co-ordinated turn control that handles direction of plane. Drawing shows how these knobs direct vertical and horizontal heading of aircraft.

Latest automatic pilot even takes the bumps out of rough weather.

By GEORGE H. WALTZ, JR.

"GEORGE" has always been a handy guy to have in an airplane. He is the automatic pilot who, on prolonged stretches of straight and level flying, has saved wear and tear on human pilots. Now George has a smart younger brother who is even better, at times, than the best flesh-and-blood fliers.

"George Jr." is known in the trade as the Sperry A-12 Electric Gyropilot and in the Army Air Forces as Type E-4. This new robot can hold an airplane at any desired altitude, minute after minute and hour after hour, *without varying 20 feet up or down.* If a sudden updraft or downdraft forces the airplane up or down as much as 20 feet, the gyropilot immediately puts the plane into a

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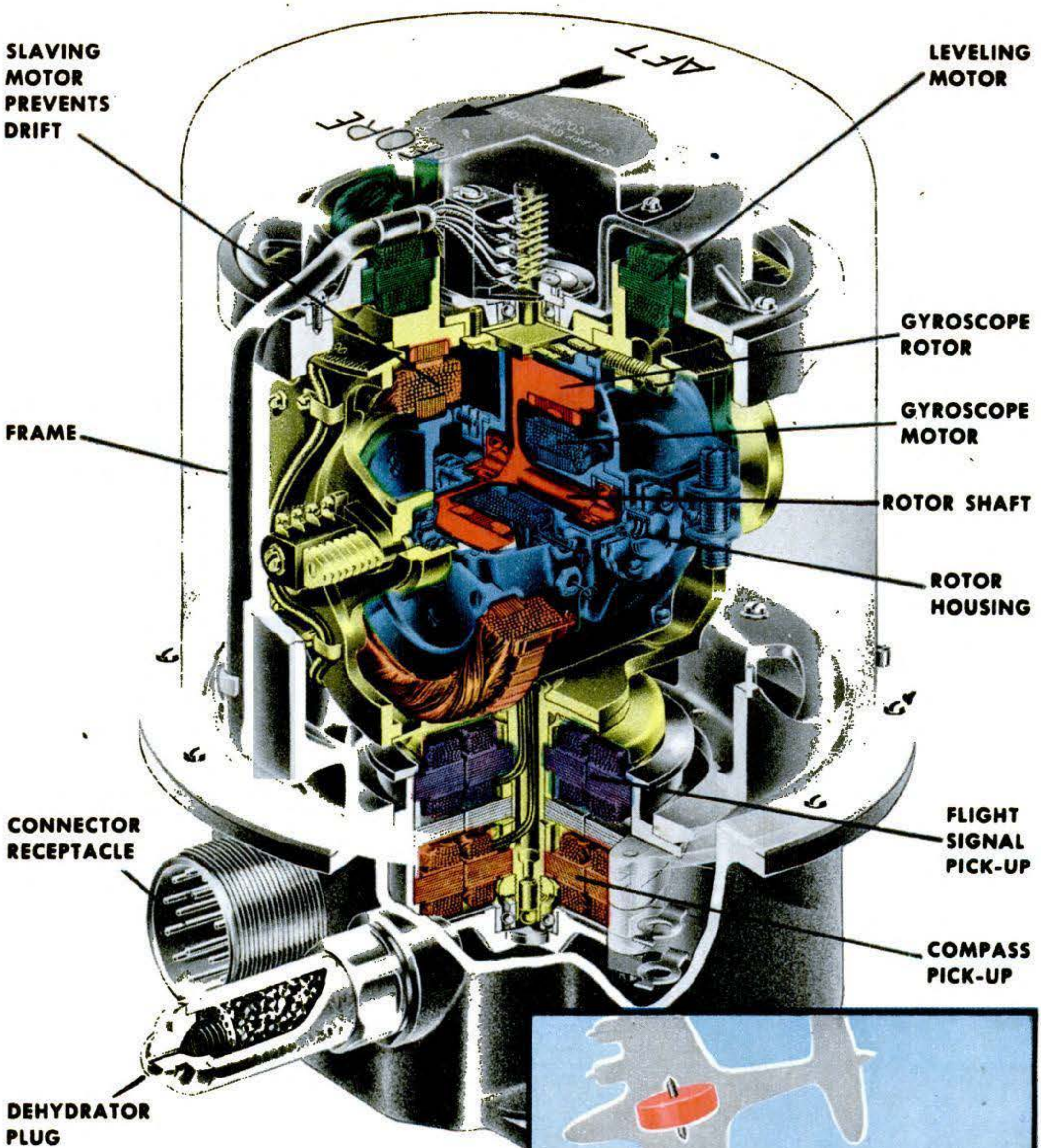

safe glide or climb to return it to its original altitude. It can automatically maneuver a plane through perfect turns at any airspeed. By literally anticipating abrupt movements, it irons out an airplane's bumps in rough or choppy air. It can fly a true straight-and-level compass course without continual checking or adjustment. And, as if these weren't enough, it can find an airport and then fly the plane down a sloping radio beam through scud and overcast for a perfect "no hands" approach to the airport's runway!

All of these automatic functions, moreover, can be put into operation simply by moving switches and knobs on a master control box, about the size of a midget table radio, mounted in the airplane's cockpit within easy reach of the pilot and co-pilot.

Top cutaway shows the gyrosyn compass control. This flies the airplane on any desired magnetic bearing, keeping it headed in the right direction without adjustment, unlike earlier models. A variable transformer pick-off detects angular movements of the plane in relation to the gyro and operates a servomotor that turns the rudder to bring the plane back on course. Drawing shows how gyro direction remains constant.

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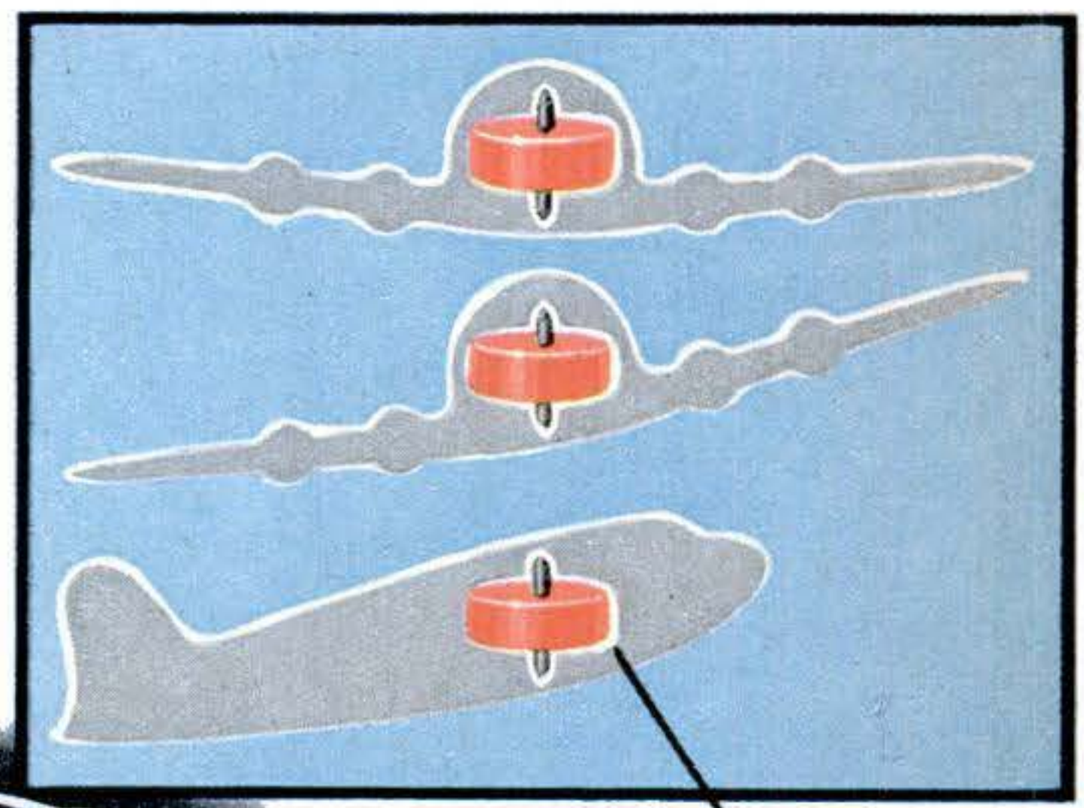
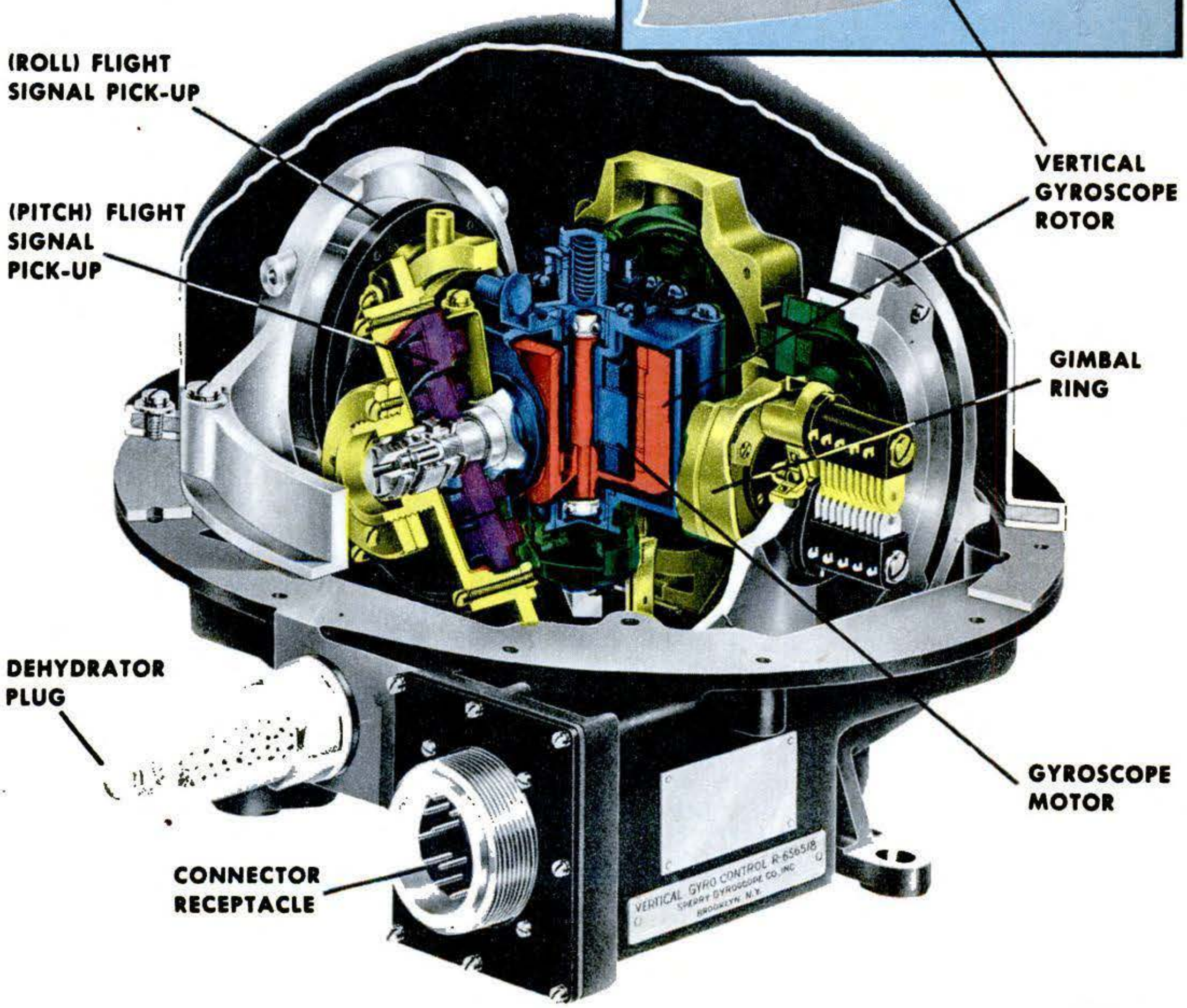
Turning a horizontal knob on top of the control box right or left operates rudder and ailerons to put the plane into a perfectly stabilized and co-ordinated turn, either right or left, in which the plane's angle of bank is adjusted automatically to agree with the plane's airspeed to avoid slipping or skidding. Turning a wheel at either side of the control box forward or backward moves the elevators down or up to put the plane into a glide or a climb. Flicking a switch puts the automatic altitude control into operation.

Basically, the new gyropilot operates on the same gyroscopic principles used in older automatic pilots (PSM, July '45, p. 86), but it is quicker, smoother, and operates with less effort on the part of the human pilot. For straight-and-level flight, a master brain in the form of a vertical, electrically driven gyroscope controls the plane's pitch and roll. Regardless of what the plane does, the spinning wheel of the gyroscope, universally mounted in gimbals, tries to keep its axis vertical. In doing so, it operates variable transformers built into its case, which in turn send electrical signals through an amplifying system to small motorlike con-

Drawing immediately below shows how gyro remains level despite pitching or rolling of the plane. Cutaway reveals mechanism of vertical gyro control, containing an electrically driven, vertical-spin-axis gyro. Two variable transformer pick-offs detect the angular movement of the plane about the pitch and roll axes and activate servomotors that control the elevators and ailerons, bringing the aircraft back to a level position. At the same time, the gyro controls actually anticipate the amount of effort that is going to be needed to keep the plane stable, and apply it so quickly that the aircraft flies smoothly even in rough weather. The gyro is limited to a maximum of 85 degrees pitch or roll. Both the vertical gyro control and the gyrosyn compass control are rigidly mounted away from the instrument panel.





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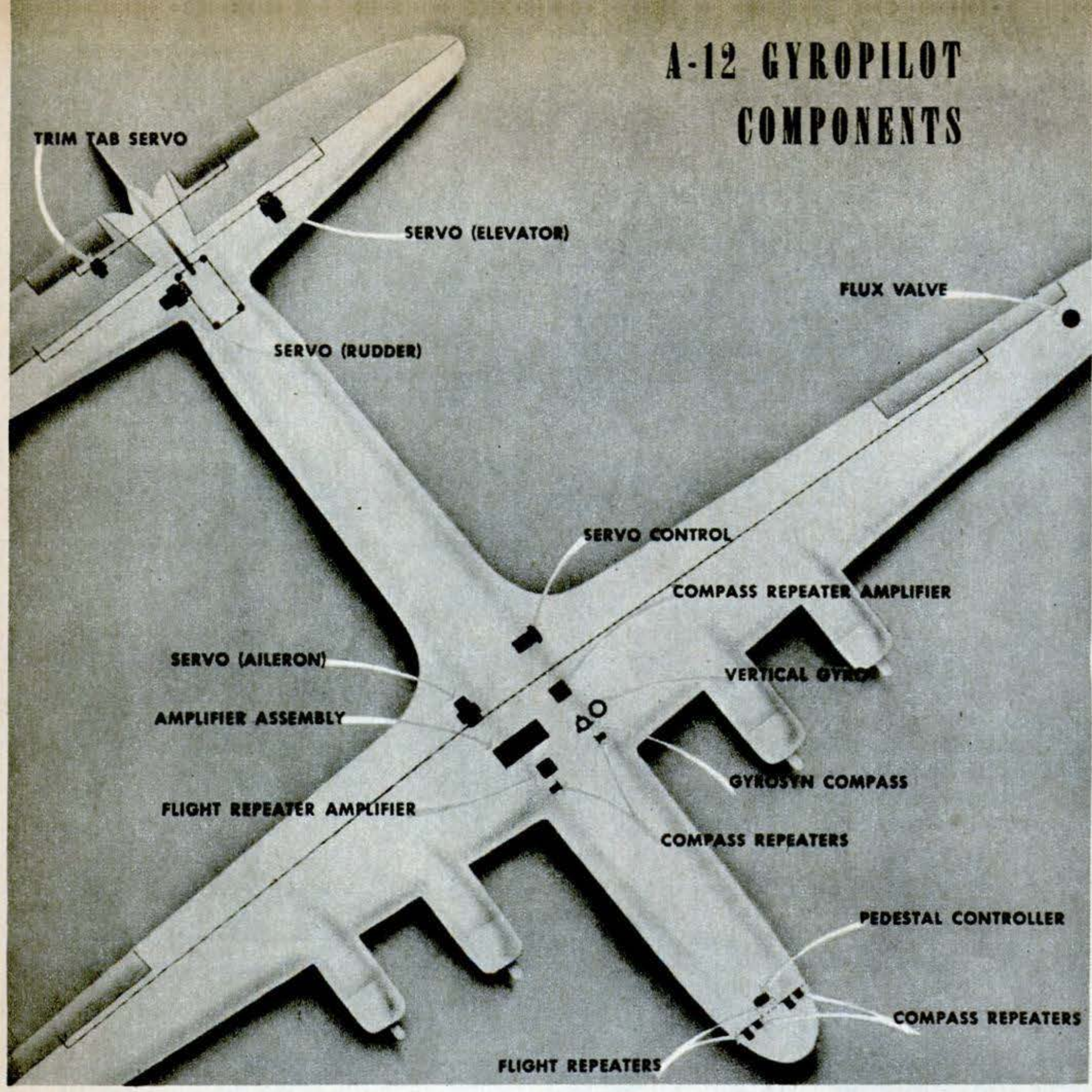

trols that move the plane's elevators and ailerons in the right directions and at just the right rates to keep the plane flying level. At the same time, and in the same way, a special gyro-stabilized compass control operates the rudder to keep the plane's nose pointed steadily toward any chosen compass heading and to fly the plane on its course.

By manipulating the master control box, a human pilot uses the same sensitive gyroscopic controls to maneuver his plane through perfect turns, climbs or glides. A plane can be handled from the time it leaves the ground on take-off until it is on its final approach at its destination without ever touching its conventional controls. The knobs and switches on the control box give a pilot and his co-pilot completely automatic stabilized control of the aircraft at all times. If desired, a further refinement in the form of a single pistol-grip flight controller can be substituted for the pedestal controls.

By feeding the radio signals from a standard localizer-and-glide-path radio landing system (PSM, Mar. '46, p. 74) into the new gyropilot, a plane can be led automatically toward an airport and then down a precise sloping landing beam to a point a few feet above the runway, where the human pilot can take over for the actual landing. This feature of the new gyropilot was demonstrated recently at a New York airport by United Air Lines, which is installing the new equipment in 23 of its four-engine DC-4s and in two of its smaller DC-3s. In the demonstration, a DC-4 repeatedly made perfect landing approaches in fairly rough air; its human pilots did not touch the controls until just before the moment of actual landing.

So far, a dozen of the world's major air lines have chosen the new gyropilot for installation in their new planes. Putting the automatic landing approach system into full commercial use, however, will take about two years. Pilots and co-pilots must be taught to use it, and ground facilities must be installed before the new "George" can be given the job of bringing all air liners in for automatic blind landings at the nation's principal airports. END

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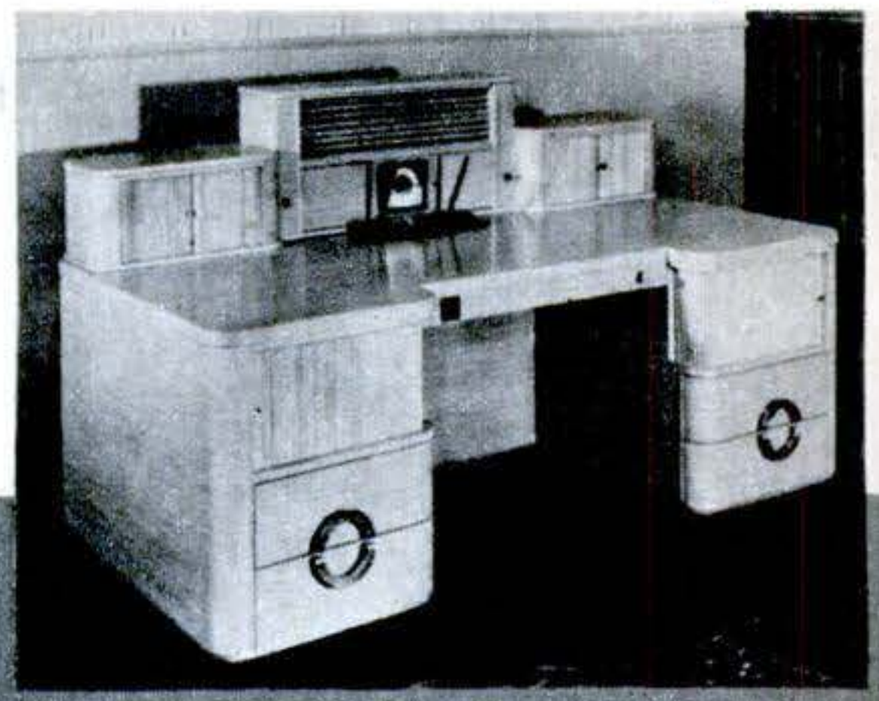
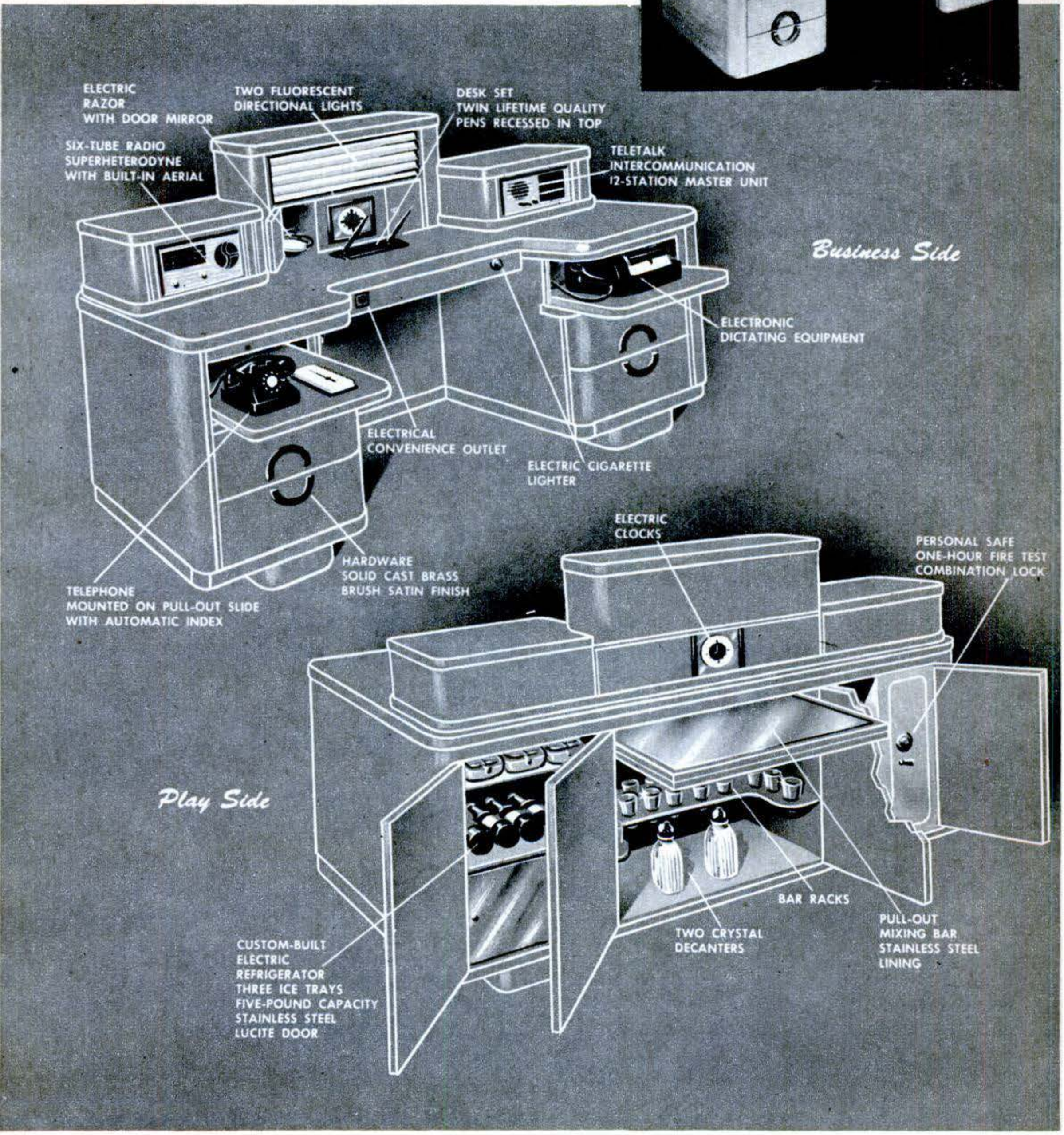
FOR *Fun-Loving* EXECUTIVES

THE makers of this postwar "dream desk" imply that it began as a designers' joke, but its reception at a Chicago exhibit has brought it into actual, though limited, production. All set for work or play, as the drawings indicate, it is made by the Gunn Furniture Co., of Grand Rapids. The price: "Well into four figures."





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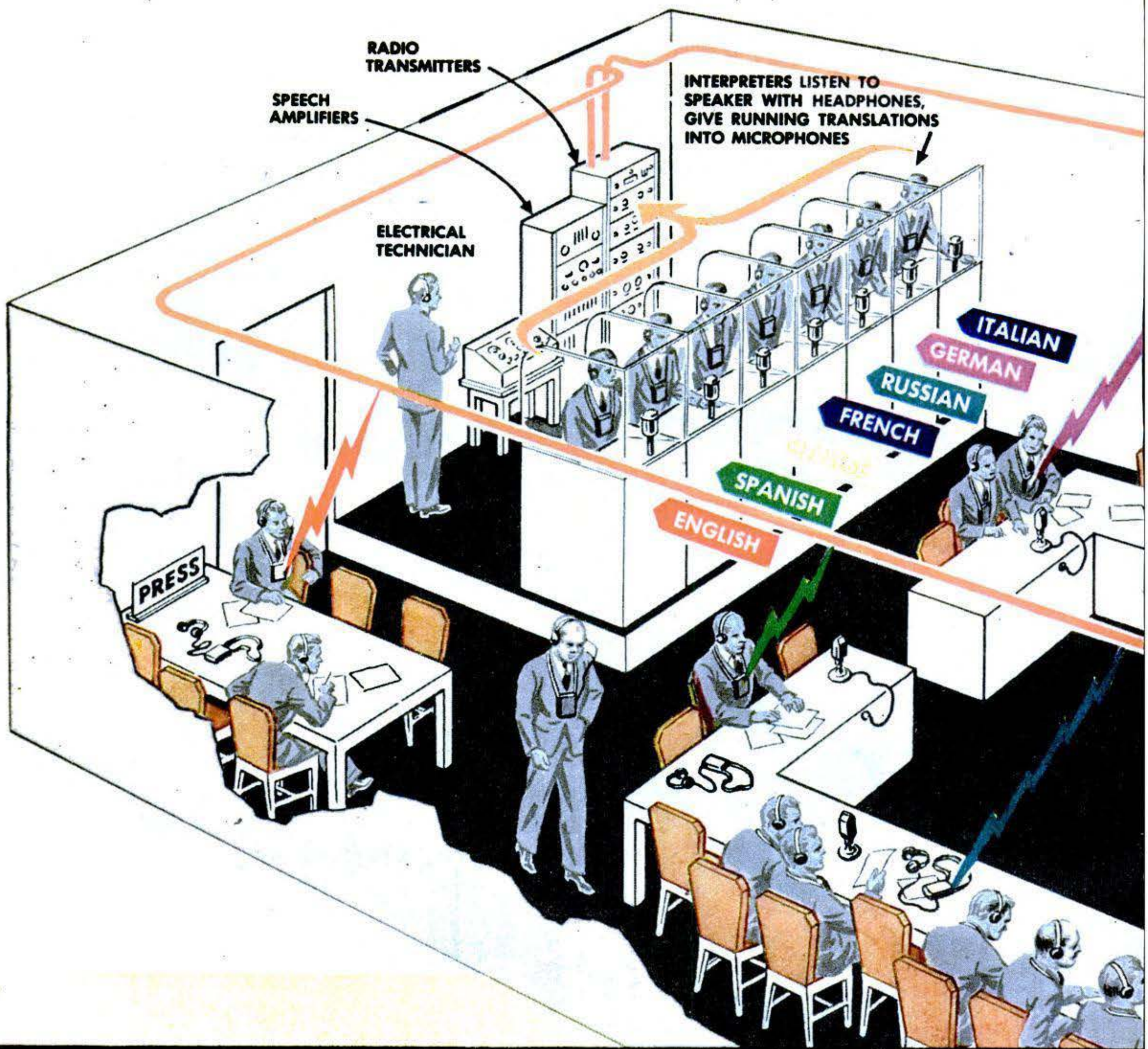

VIRING DIPLOMATS FOR SOUND

Illustration by STEWART ROUSE

MIDGET radio receivers slung from the wearer's neck—"walkie-hearies"—now enable delegates to international conferences to hear a speech in their own language at the same time that it is delivered in another. Running translations in seven different languages can be broadcast simultaneously.

The battery-powered radio receivers, no bigger than a camera, are completely self-contained, allowing listeners to move about freely. Aerials in the neck straps pick up the radio signals from a transmitting antenna that rims the room.

When the radio translator system is in operation, seven interpreters sit in booths equipped with earphones and microphones. As each interpreter catches the speaker's words through his headphones, he translates them extemporaneously into his microphone. If the speaker goes too fast, the interpreter can push a button to flash a warn-

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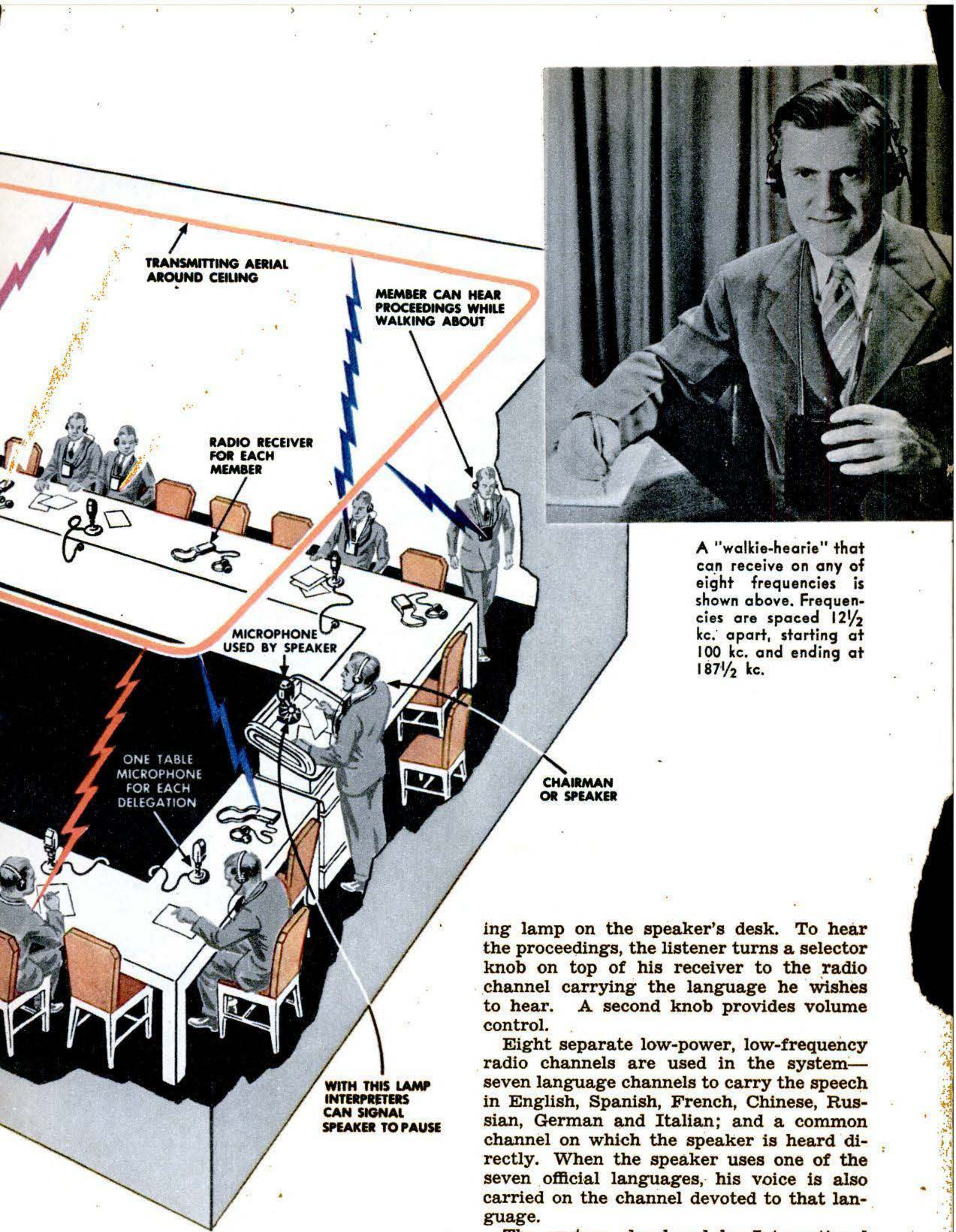

A "walkie-hearie" that can receive on any of eight frequencies is shown above. Frequencies are spaced 12½ kc. apart, starting at 100 kc. and ending at 187½ kc.

ing lamp on the speaker's desk. To hear the proceedings, the listener turns a selector knob on top of his receiver to the radio channel carrying the language he wishes to hear. A second knob provides volume control.

Eight separate low-power, low-frequency radio channels are used in the system—seven language channels to carry the speech in English, Spanish, French, Chinese, Russian, German and Italian; and a common channel on which the speaker is heard directly. When the speaker uses one of the seven official languages, his voice is also carried on the channel devoted to that language.

The system, developed by International Business Machines Corp., was used for the first time recently at the World Conference of the Teaching Profession at Endicott, N. Y.

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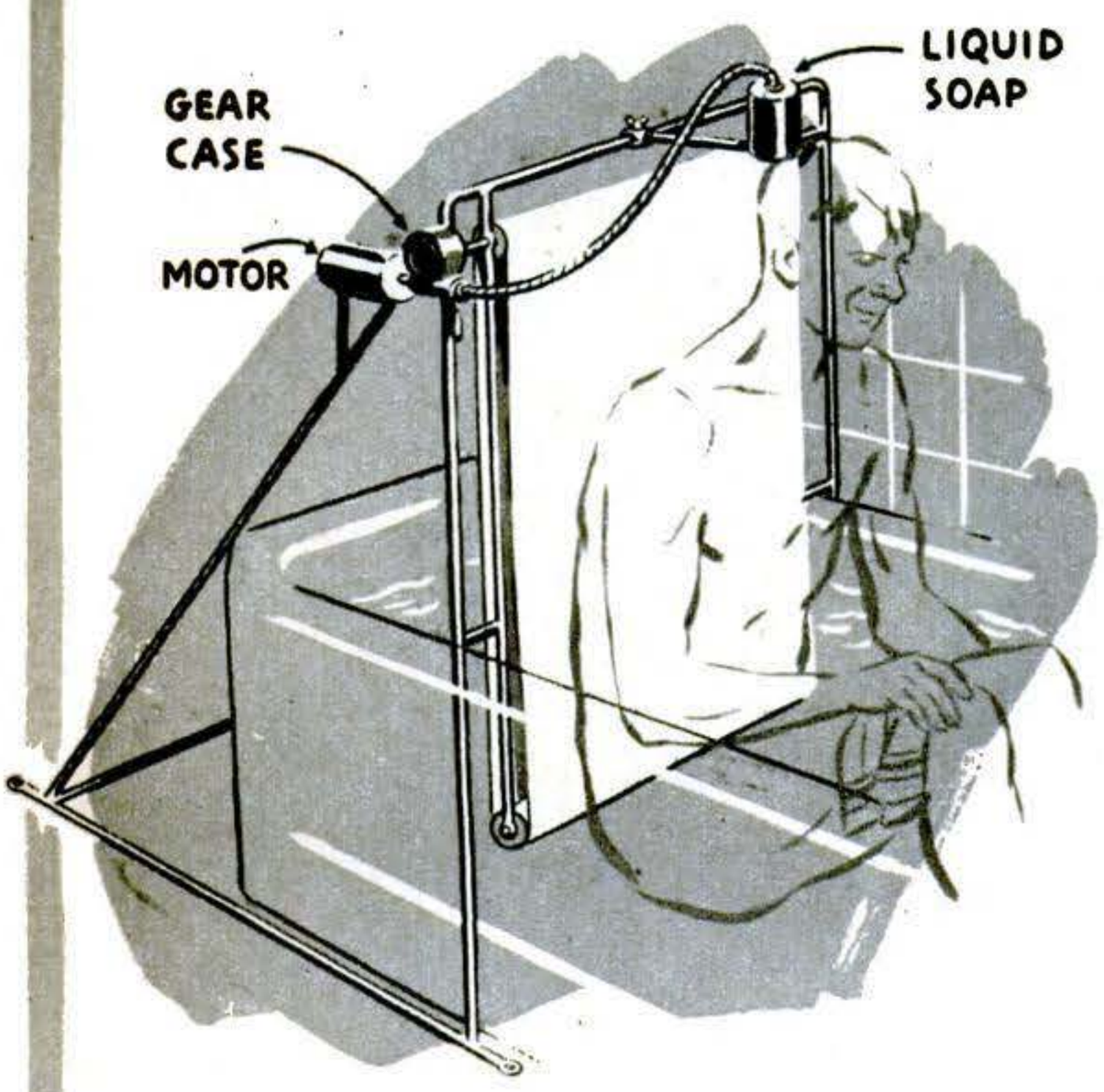
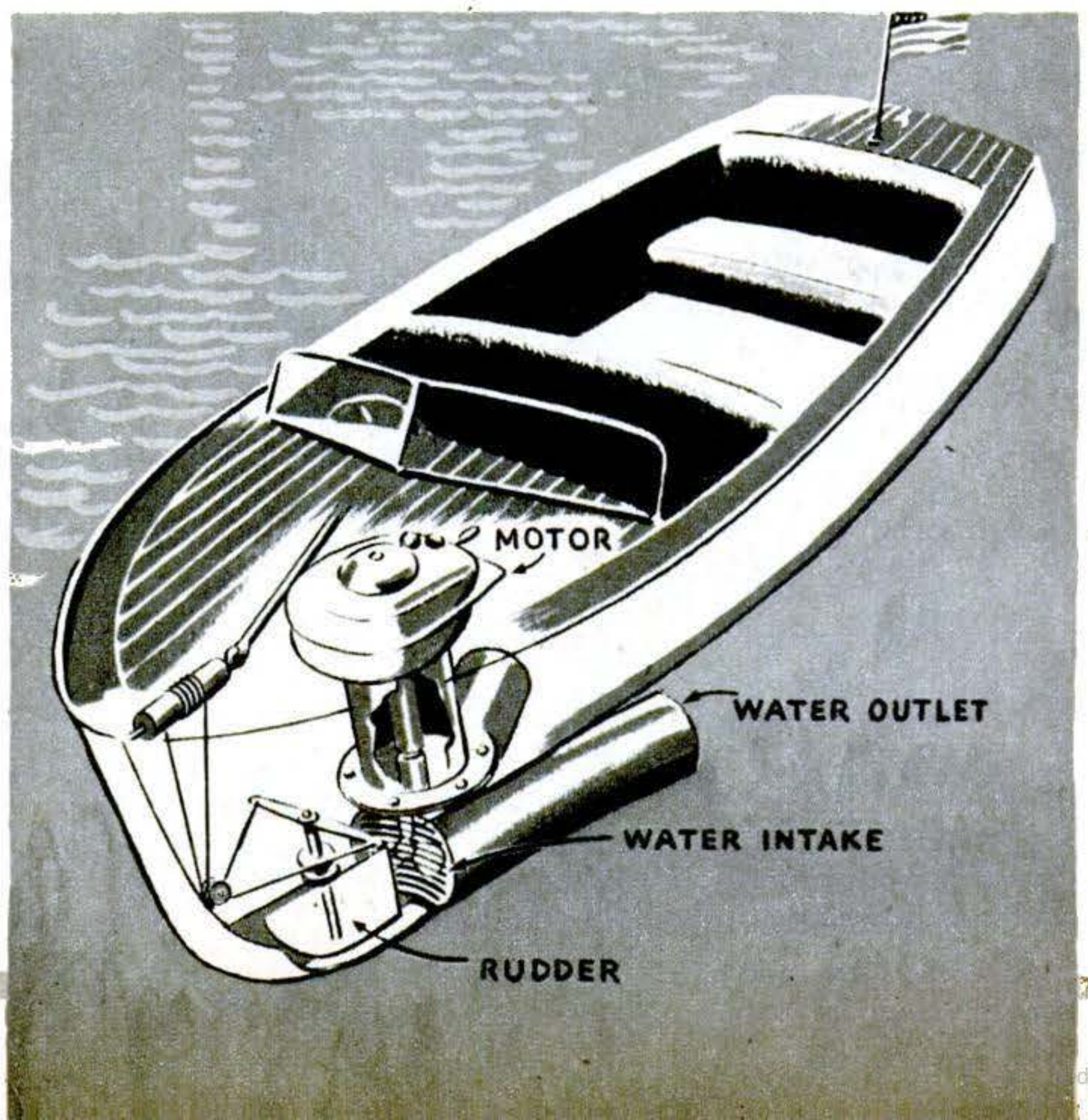
NEW IDEAS from the INVENTORS

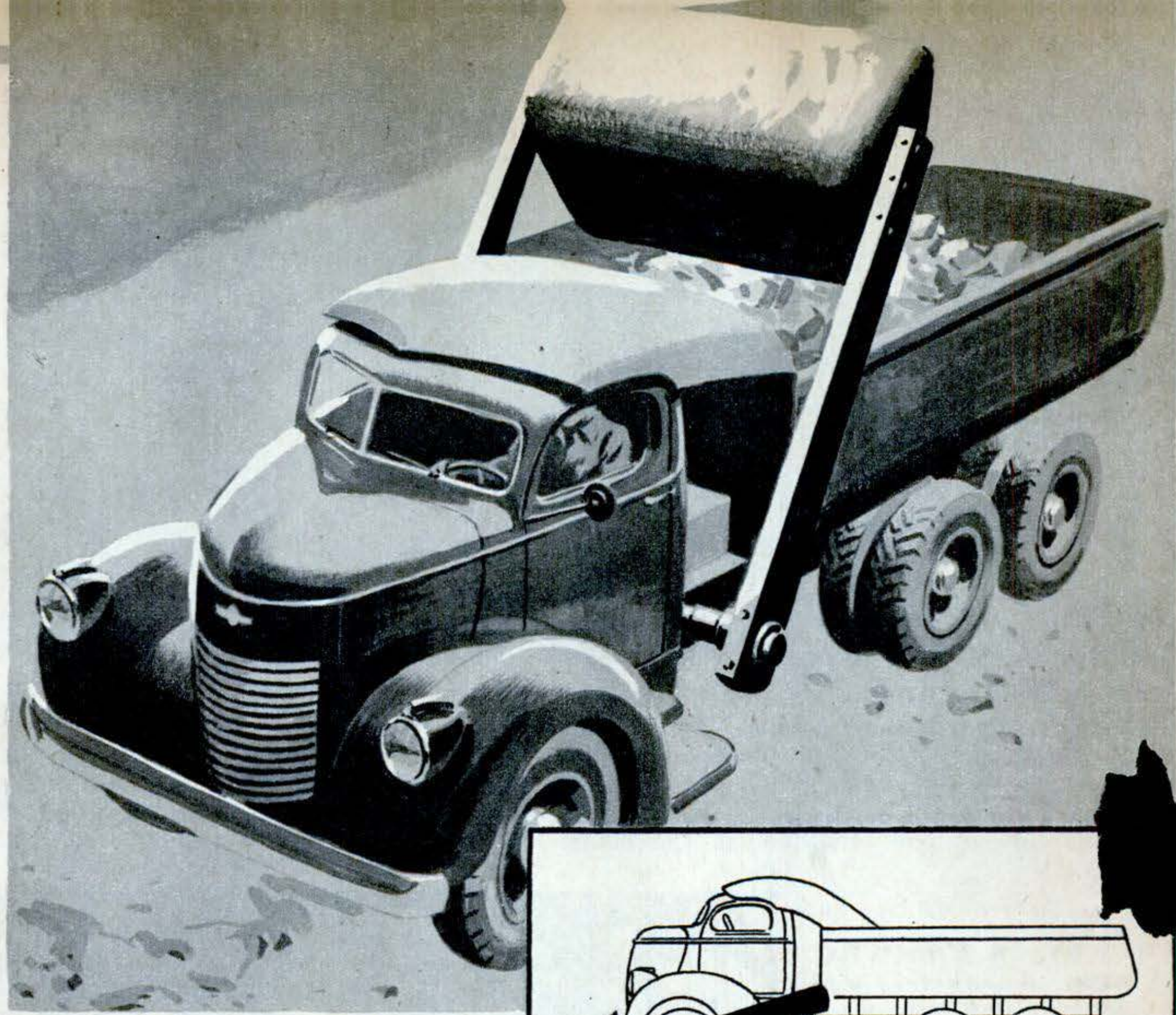
Clothespin Dispenser. To end fumbling in a bag or apron pocket for clothespins, Samuel Geller, of Brooklyn, has made a dispenser that can be fastened to a clothesline post. The rustproof steel box holds 84 pins. As a pin is slipped out another takes its place. It preserves pins in all weather—and keeps them clean.

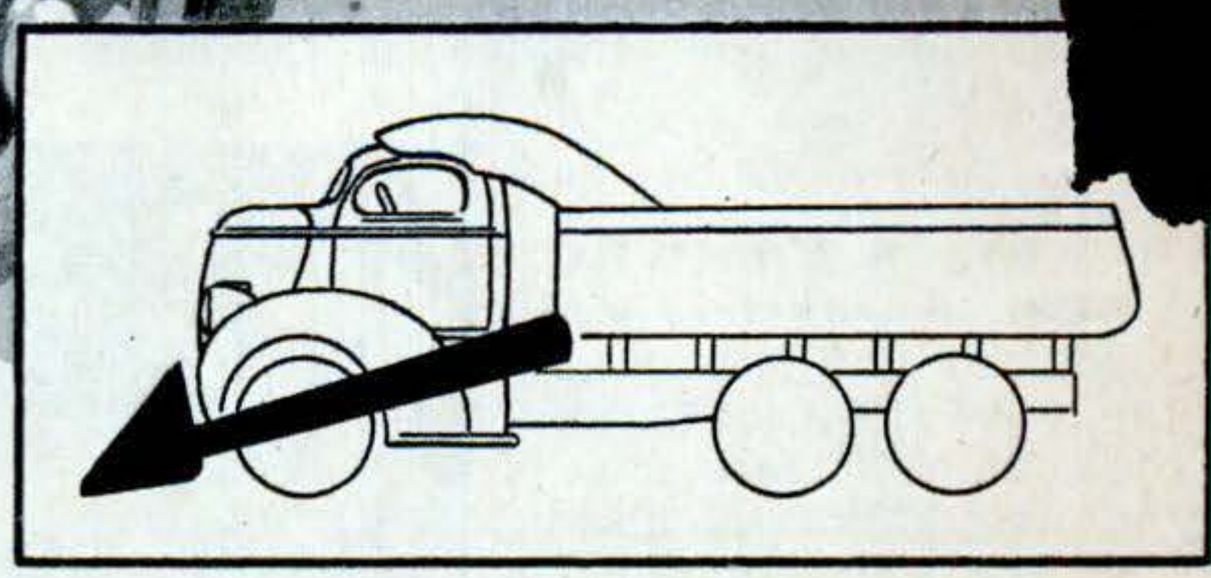


Bathtub Valet. It was inevitable that the Machine Age would come up with a mechanical back-scrubber, left. William Dixon, of Henderson, Ky., has devised a standard that fits over one end of a bathtub. Across its top is a motor-driven roller, while two arms reach down under the water of the tub and support a free-turning roller. An endless towel is stretched over the two rollers and fed with liquid soap from a container at the top of the standard. User just leans back.

Bow-Driven Boat. In his patent for a motorboat with an engine up front, Renwick J. Sharp, of Guatemala, claims that his design assures greater efficiency by keeping the propeller below the surface of the water at all times. In stern-propelled motorboats, the screw is often out of water, wasting energy and increasing wear and tear on the engine. Sharp also contends that with the rudder in the bow, steering responses are quicker. The improved housing is said to provide more protection against weeds and flotsam. Motor and propeller are removable for safe-keeping.

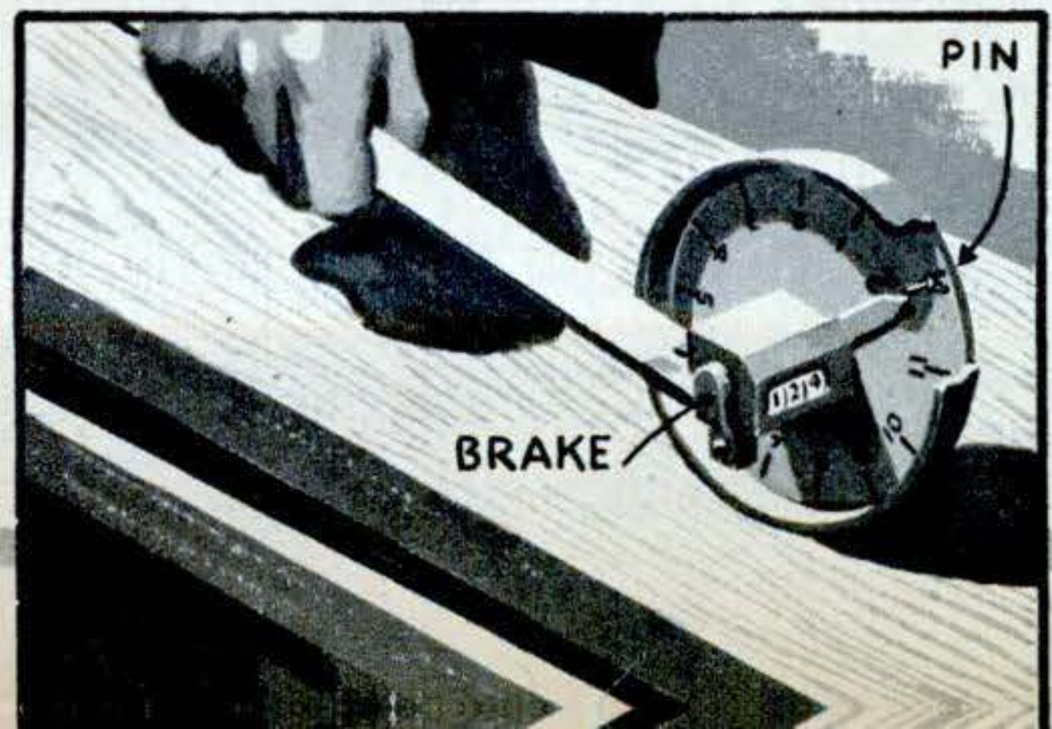






More Muscle for Trucks. A novel booster cylinder devised by Roy H. Frost, of Fresno, Calif., helps hydraulic front-loading dump trucks get that load up over the cab. The added cylinder, connected in series to the regular power cylinder in a fluid pressure system, goes into action when the scoop is on the ground. Since the load must be lifted from 15 degrees below the horizontal, this is the moment of greatest strain. The booster has a short stroke and comes to the end of it after the scoop has reached a relatively easy lifting position. At that point all the fluid pressure goes into the main power cylinder and it finishes the loading of the dump body.

Measuring Wheel. You can both see and hear how far you have measured with a pocket wheel invented by Frank B. Harmon of Clifton, N. J. A counter records the number of turns, while at the same time a pin trips a spring with each revolution, producing an audible click. The wheel is graduated for measurement of distances less than one full turn. A folding rule can be used for the handle.



For Baby. A nursing bottle, with a thermometer held in the side so that it cannot slip or become detached, has been patented by Logan Eisele, of Nashville, Tenn. The thermometer niche has a flat bottom and sides that taper from center to each end. A transparent retaining plug of glass wedges into the depression and holds the thermometer.

Drawings by FRANK L. HUBBARD

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Newest Aeronca. Scheduled for assembly-line production early this year, the two-place Chum is the Aeronca Aircraft Corporation's latest entry in the personal-plane field. Powered by an 85-horsepower fuel-injection engine, it attains a top speed of 115 m.p.h. and cruises at 105 m.p.h. The Chum has simplified controls, tricycle gear, and a metal fuselage that will be stamped out to facilitate construction. A new Aeronca plant located in the Midwest will manufacture the plane.

France's Postwar Cars. Among the new automobiles on display at the 1946 Paris Auto Show, the first held there since the war began in 1939, were the little "four-chevaux" Panhard (right) and the elongated, underslung Delahaye "Competition" (below)—the long and the short of modern French automobile design.

Wrap It Up!

New-style packaging handles a bottle of milk — or a bomber.

Drawing by R. M. Hollingshead Corp.

An artist illustrates how one of 1,400 reserve B-29s was prepared for outdoor storage with a protective spray. The milk bottle in the inset has a Pliofilm hood, increasingly used by dairies.

By MARTIN MANN

IF THE grocery clerk tells you some day soon, "Sure this bread is fresh—it came in only 10 days ago," he won't be kidding. New packaging methods promise to take many foods out of the perishable class. Butter, peas, apples, oranges, carrots and a long list of other fresh produce, as well as bread, have been stored successfully for periods of time previously considered impossible. The trick is not preserving processes such as cooking, canning or freezing—it lies in containers made of new and improved foils; plastic films and chemically treated papers; and, in some cases, in the packaging of items never before wrapped.

Outside the grocery field, too, new packaging ideas forecast superior goods for less money. From hypodermic needles to dolls, acid bottles to washing machines, countless products are benefiting from better wraps and containers.

Many of these packaging innovations were developed just before the war, only to be set aside as more urgent needs claimed scarce materials; others were spurred from the laboratory by the demands of the war itself. The war caused a revolution in the packing of durable goods like machinery and equipment, and these techniques are now being continued in peacetime industry. Methods created to insure safe arrival of airplane engines and guns anywhere in the world under any conditions are now being used in the distribution of typewriters, sewing machines and ordinary hammers in perfect order at less expense.

The most startling results, however, have been obtained with foods. Bread, for instance, will stay oven-fresh 10 days when sealed in an aluminum foil wrapper. Even longer keeping periods are reported for a German process that coats the loaf with a polyvinyl acetate emulsion. When this covering is stripped off eight months later, the bread shows only slight signs of interior mold. Still another method, also applicable to butter, impregnates the ordinary paper wrapper with a special chemical that stops mold growth without affecting the bread.

Fruits furnish a second example. If

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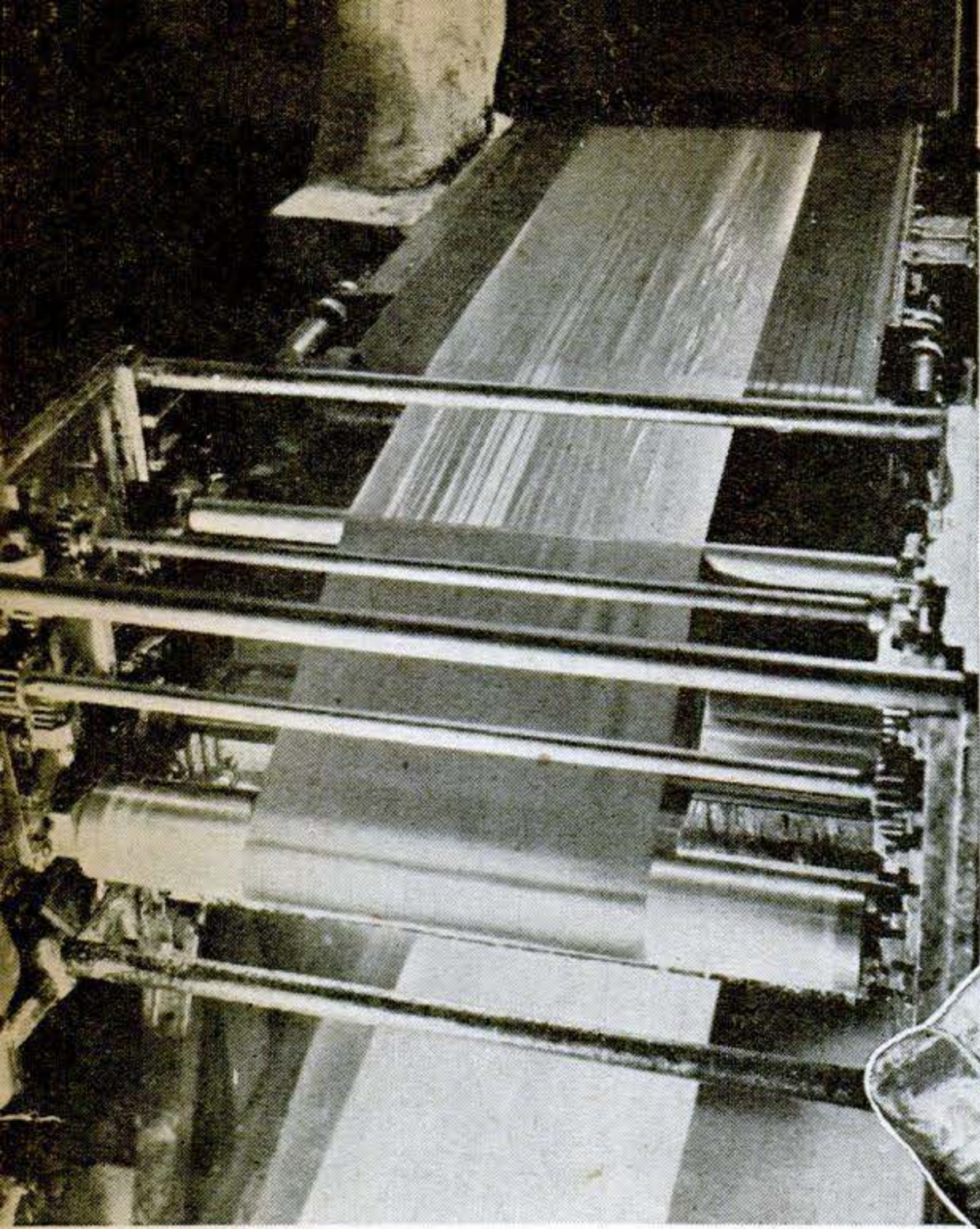
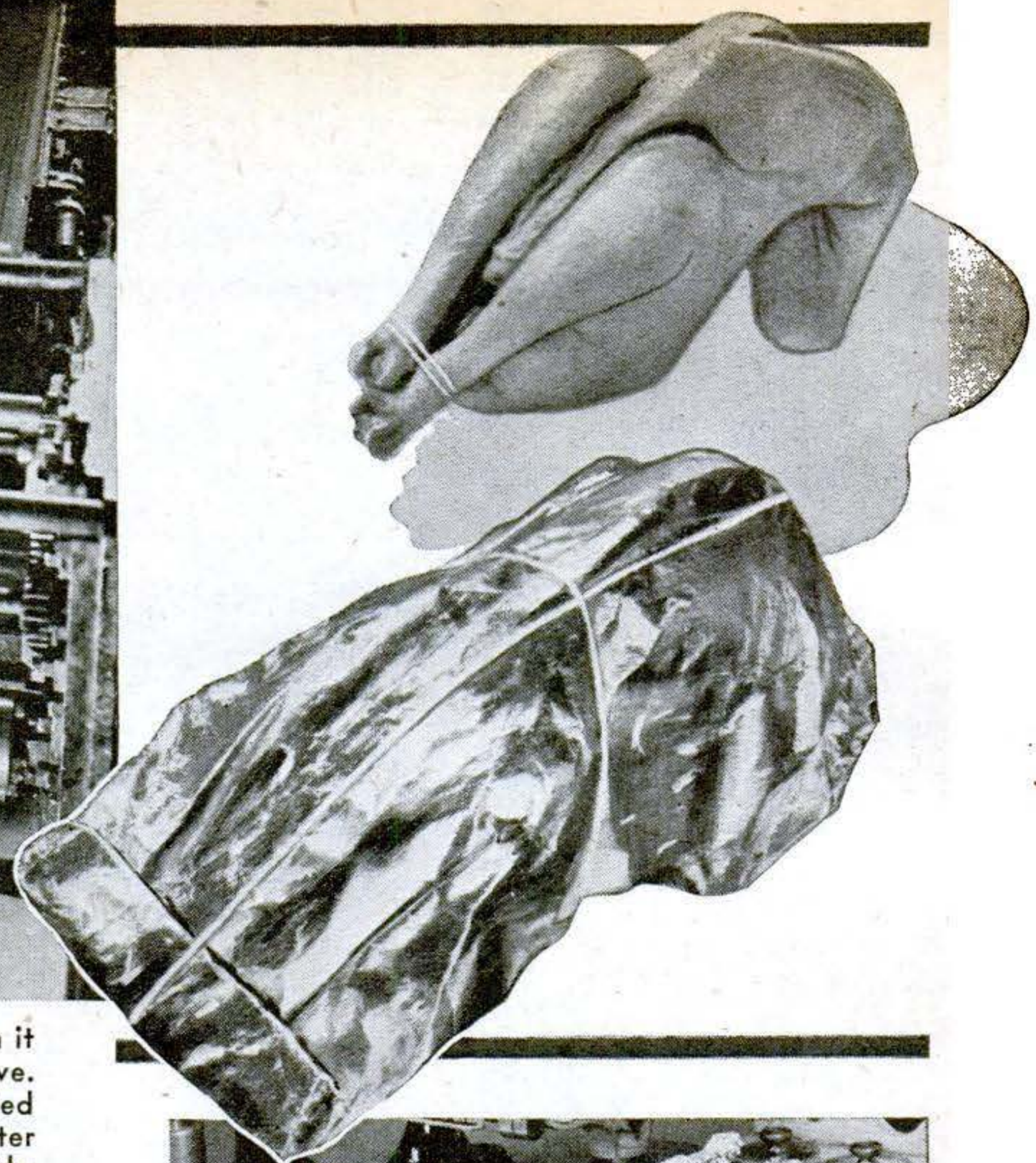
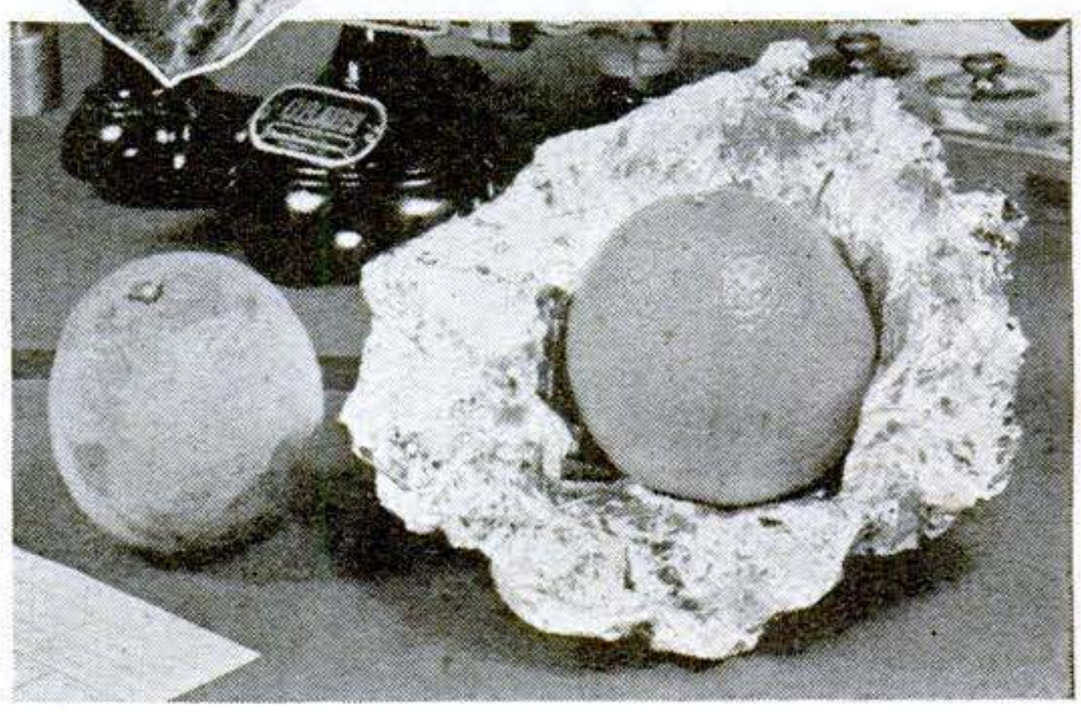




Aluminum foil takes on a lacquer finish when it is run through a lacquer bath as shown above. Then the foil, which is .001-inch thick, is baked in ovens. The foil is lacquered for better sealing and to protect against food acids. It is an Aluminum Co. of America product.



At top a turkey is shown before and after being wrapped in aluminum foil. The pliable wrap fits any object and allows folds that seal tightly. Contrast condition of the wrapped and unwrapped oranges.

you're tired of buying fresh oranges that rot before you can use all of them, new waxes, plastics and metal films ought to end your annoyance. Citrus fruits sealed in Pliofilm, a transparent rubber compound, or in an aluminum foil, keep as long as six months. New wax-spray techniques prevent spoilage of lemons for four months. Carrots, typical of the vegetables that spoil a few days after picking, can be stored under refrigeration in Pliofilm for 18 months. Fresh sweet corn keeps two weeks.

And this better produce should cost the consumer less than he pays now. Reduction of the present 25 percent spoilage loss is expected to save millions of dollars, while automatic machinery will keep wrapping expenses extremely low—about the same as it now costs to apply the twisted tissue covers that frequently do little more than hide blemishes.

Since the materials and machinery required for most of these new packages are still in short supply, spoilproof groceries remain a convenience of the future. Promising results have been obtained, however, from large-scale tests of a slightly less effective but more easily adopted method of "pre-packaging," which for some years has been used on choice tomatoes and limes. Garden truck like peas, carrots, lettuce and cauliflower, ordinarily shipped to market in bulk, is instead wrapped—but not sealed—immediately after picking in paper, cellophane or whatever material is available. Spoilage reductions ranging to 17 percent for lettuce were reported by the food chain that tried pre-packaging in its Columbus, Ohio, stores.

The success of these packaging preserva-

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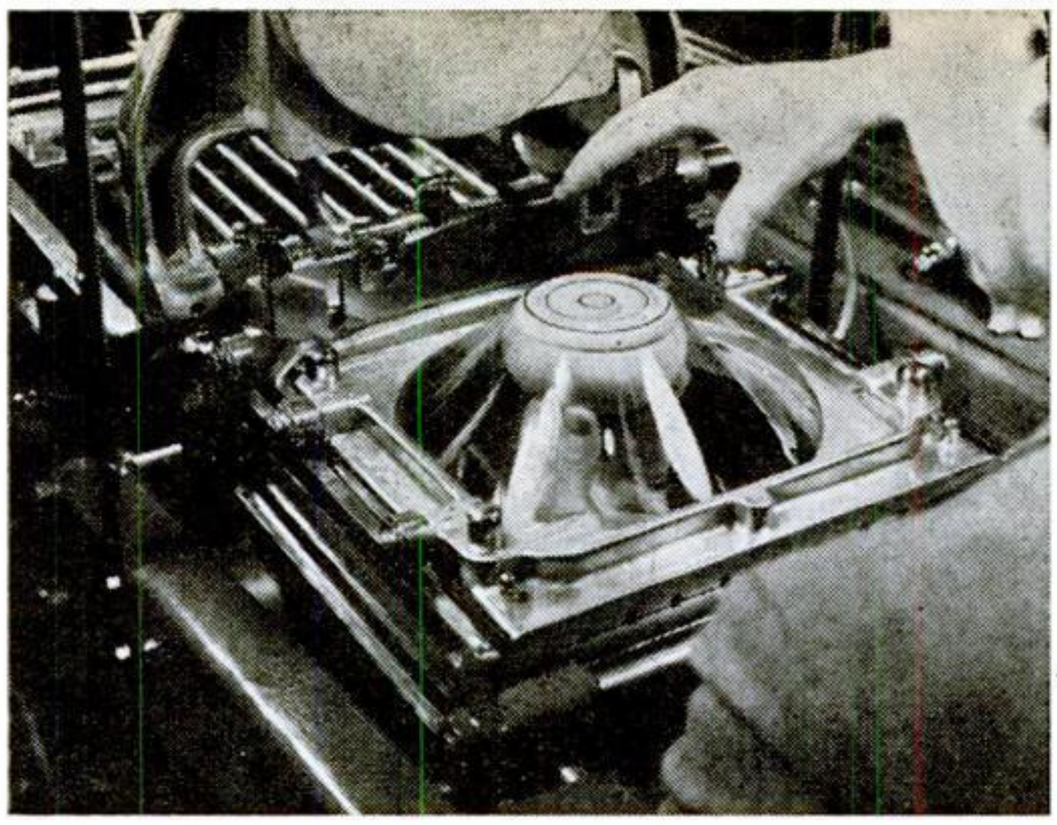
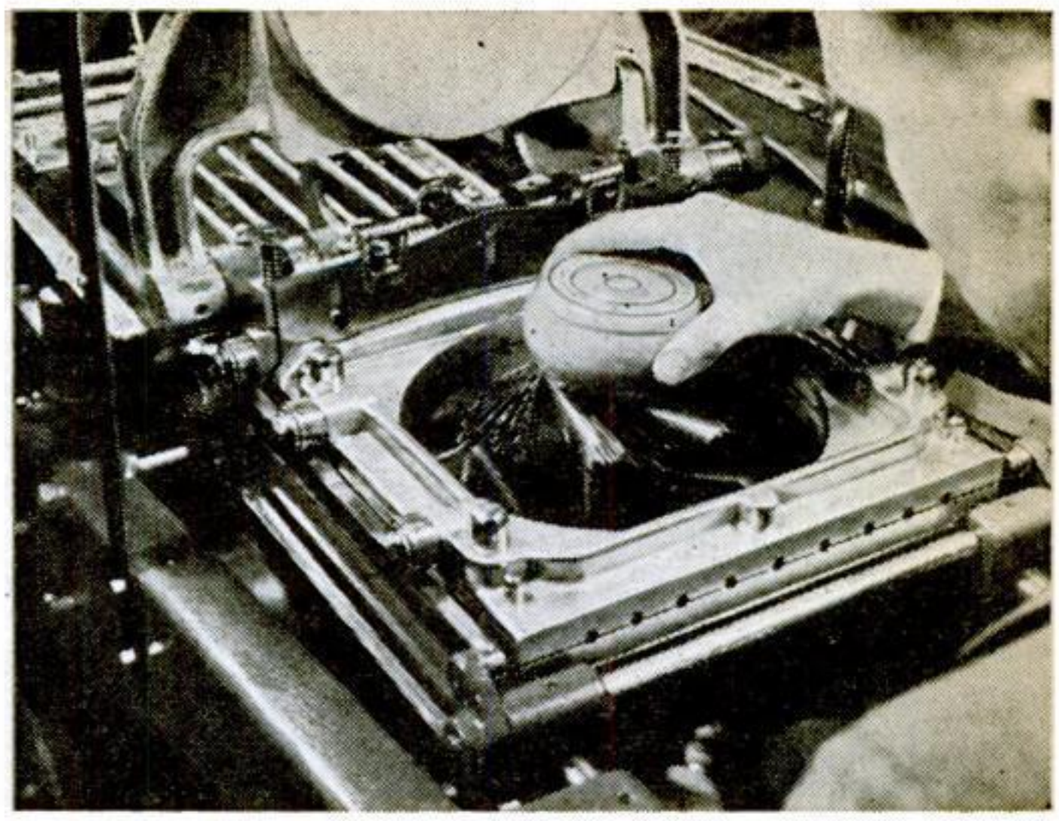


A demonstration of how one device wraps articles in vaporproof film, above, shows how the object to be wrapped is thrust up against a sheet of film.



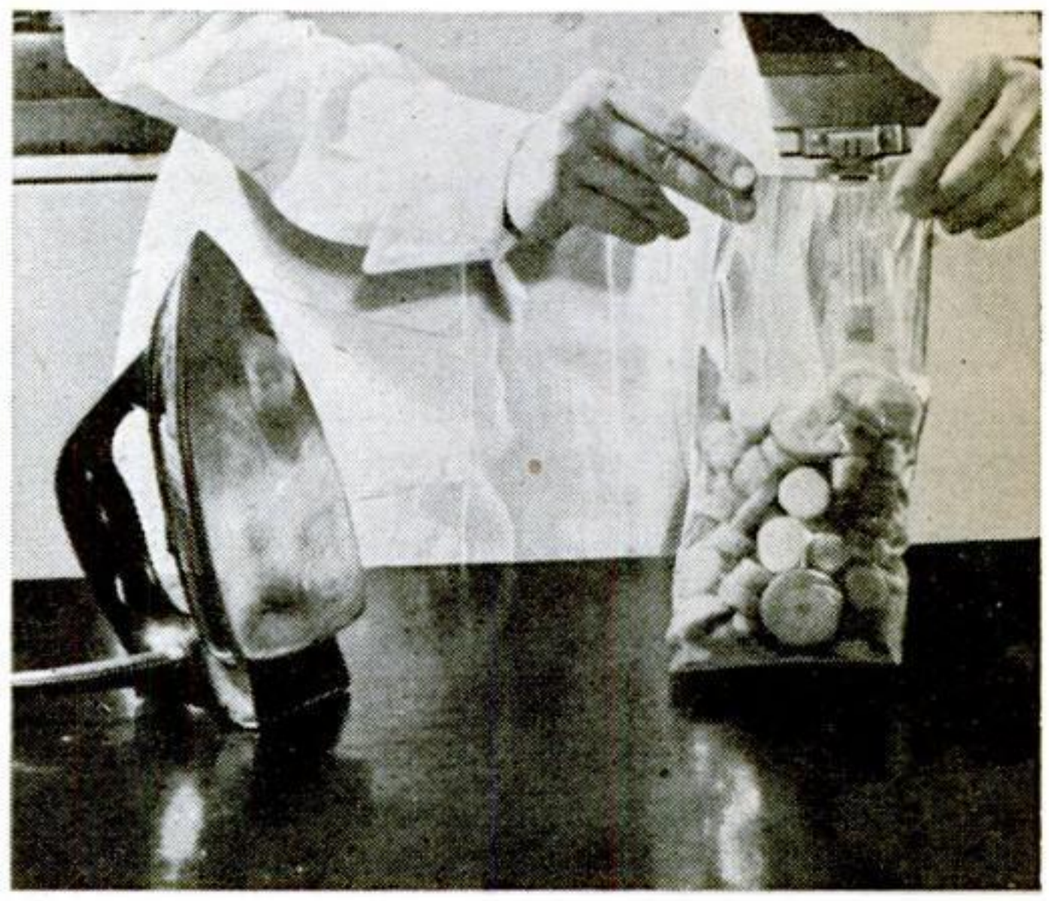
In this operation the machine catches the object to be wrapped, twists it—and it is packaged. Food and other articles are wrapped in this fashion.

tion methods stems from research into just what happens when food rots. Scientists learned that fruits and vegetables, still living after they have been picked, must continue to breathe, releasing carbon dioxide and inhaling oxygen, yet they must not lose much of their moisture.

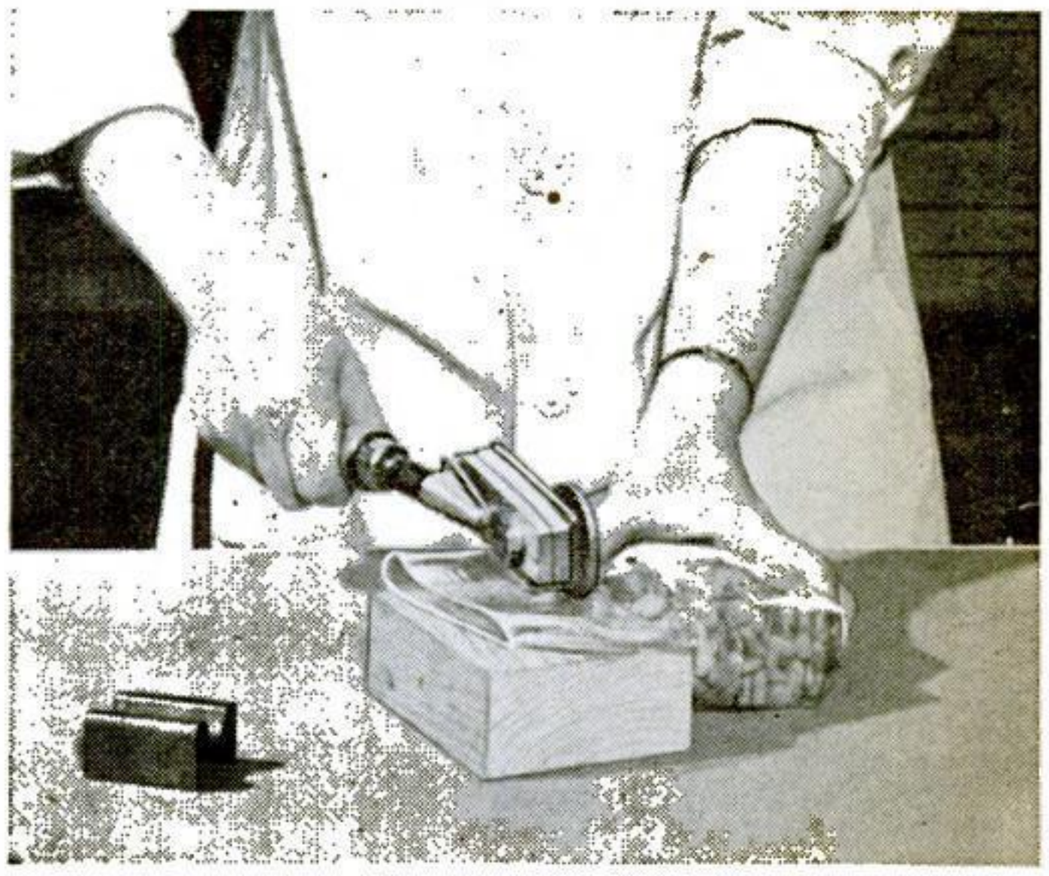
These findings explain why unwrapped produce shrivels up, and why fresh food sealed in cans or jars would spoil from inability to breathe. Most types of paper and plastic film are partially effective at retarding spoilage, as the pre-packaging test showed, since they allow breathing and prevent some, but not all, evaporation. They are waterproof rather than truly moisture vaporproof. On the other hand, the new materials will stop nearly all moisture vapor, while permitting some carbon dioxide and oxygen to pass through. These are the films that promise ever-fresh fruits and vegetables.

And they are of equal importance in the packaging of a completely different product—machinery. Only a few years ago shipping an engine overseas meant disassembling it and coating its parts with grease. This process was slow and expensive. But even worse was unpacking, with its messy, time-consuming degreasing and reassembly jobs. War, which required overseas shipment for almost everything American factories made, obviously could not wait for such slow packaging methods.

The answer was simple: Seal the engine, gun or instrument inside a vaporproof envelope so that water could not penetrate, and remove what moisture is left inside with bags of a drying agent like silica gel.



In packing with vaporproof film at home, the wraps can be sealed with a hot flatiron. Pliofilm and Saran are two new wrapping films.



A special heated roller for sealing film wraps is shown in operation. Goodyear Rubber Co. makes Pliofilm and the Dow Chemical Co. produces Saran.

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With no moisture inside and none able to get in, corrosion is impossible. Today this same process is being used on typewriters, sewing machines and many similar products.

Complete airplanes and tanks were too big to fit inside an envelope but they could be sprayed with liquid vinyl plastic, which formed a vaporproof cocoon. The cocoon, like the envelope, was easily ripped off when its contents were needed.

In addition to its obvious civilian use for the export packing of large and small machinery, this process now plays an important role in safeguarding our war-weapon reserve (PSM, Mar. '46, p. 126). Cocoons encase entire artillery pieces, the guns and machinery of laid-up warships, as well as 1,400 fully equipped B-29s. With only occasional inspection, all this vital material is expected to remain in perfect operating condition for 20 years. In an emergency it could be ready for combat use within a few days.

To protect small pieces, ingenious package engineers produced other ideas to save time, money and equipment. Delicate instruments were cushioned with foam rubber and sealed in the familiar tennis-ball can. Individual metal parts were dipped in molten ethyl cellulose to give them a tight-fitting plastic "skin" that keeps out moisture and prevents scratches. The skin could be peeled off whenever the part was needed. In a vivid demonstration of postwar uses for this last method, one manufacturer, Seal-Peel, Inc., last October shipped fragile merchandise ranging from television tubes to fresh eggs around the world by air. The plastic skin provided the only protection.

Just as the war forced development of radical packaging techniques, new peacetime industries are now demanding methods that will fill their particular needs. Deep freezing and air freight, for example, have stimulated the design of unique crates and containers.

In the case of flying freight, new packages have themselves accelerated its rapid postwar expansion. Lighter cases, which can safely be used because of the careful handling given airborne goods, reduce the weight of packed items more than enough to make up for the higher pound-per-mile rate. When the big saving of time is also considered, aerial shipment becomes actually cheaper for many things.

Women's dresses, made in New York, are flown to California shops on factory racks, arriving clean and unwrinkled, ready for immediate sale. Phonograph recorders are shipped completely assembled in carrying cases, their only protection a brown paper wrapper and a few strips of light wood.

But the most important product traveling by air—at least to Midwest gourmets—is fresh seafood. Maine lobster, shrimp from Louisiana and Virginia oysters are being sped with the help of new containers to dinner tables in Detroit, Chicago and El Paso.

Air shipment would have been prohibitively expensive with the old package—an ice-filled barrel that often weighed as much as its contents. So a light, iceless container, made of insulating cardboard lined with plastic film, was designed at Wayne University's Air Cargo Research Center.

Before packing in the new case, the fish is cooled to 34 degrees F. The insulating box then prevents a temperature rise of more than about one-half degree per hour. Since seafood is never en route more than 24

Chilled to 34° F., shrimp are being placed in Pliofilm bags, at left, before being stored in Insulpak containers, shown below, for air shipment. The shrimp, packed 40 pounds to a bag, will gain temperature no faster than half a degree each hour.

Photos by Chicago and Southern Air Lines

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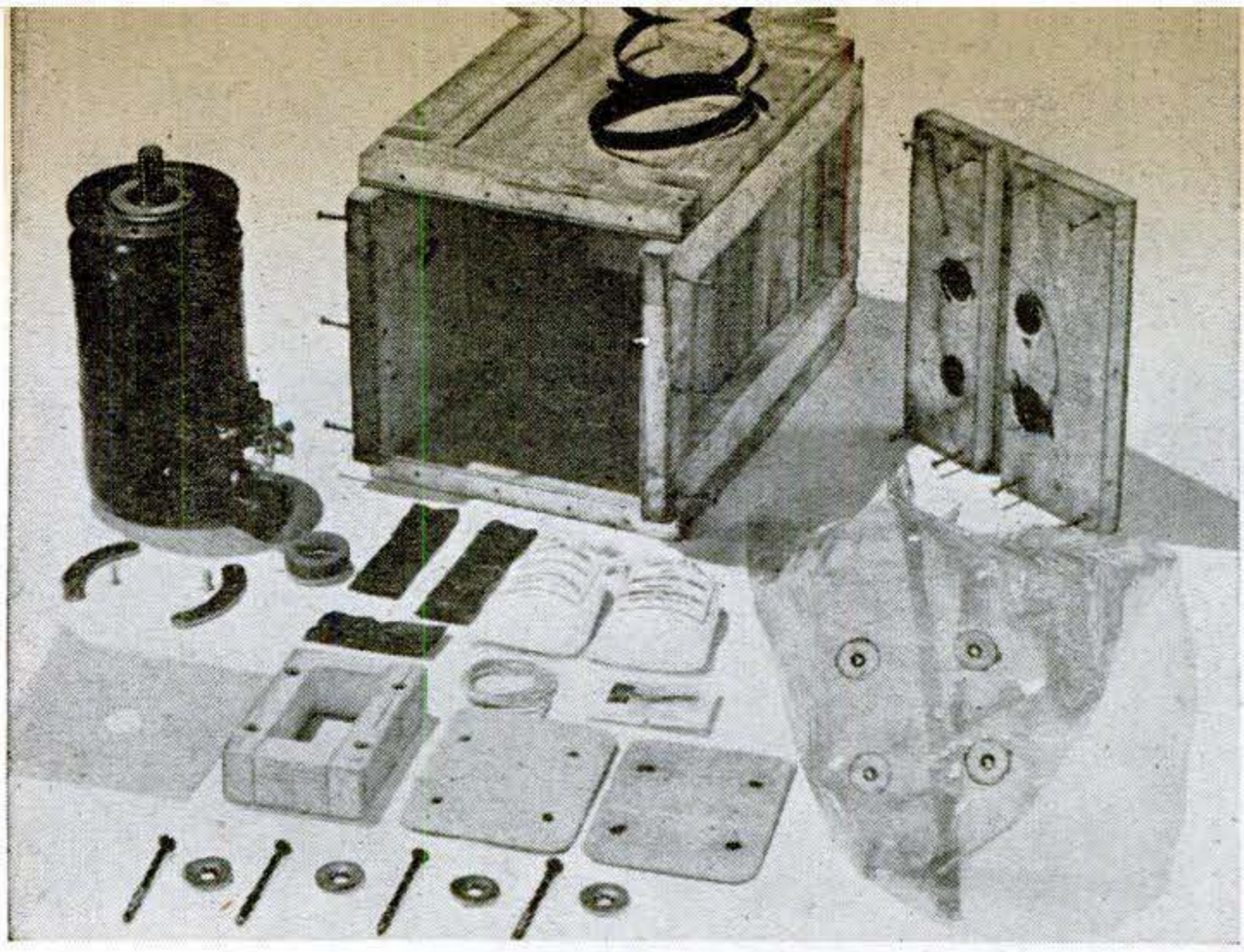
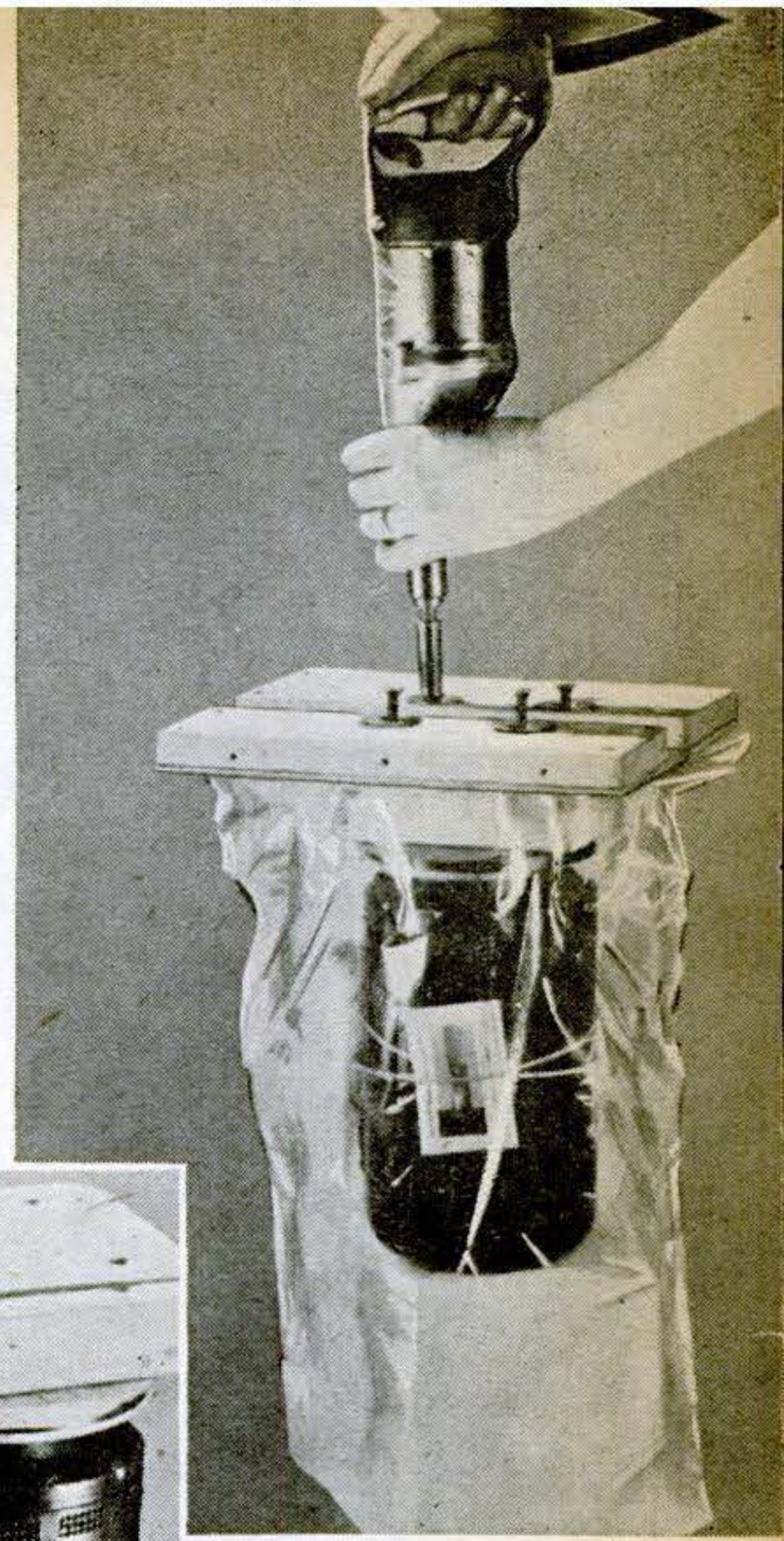
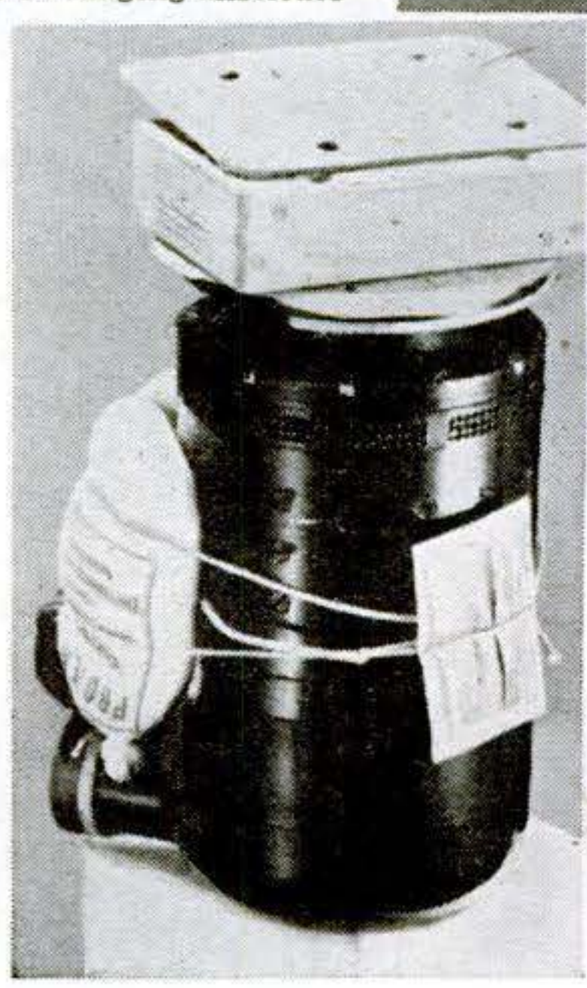


The complete assembly of parts needed to ship a generator and protect it from tarnish, corrosion, rust and mildew is shown above. Packaged in this fashion, it can be left in storage indefinitely.

Photos by Flexible Packaging Institute





Above: A generator to be shipped is anchored to a baseboard to protect its vaporproof wrap from punctures through shifting. Left: Bags of desiccant (drying agent) are placed around the article. Card warns of moisture in envelope.

hours, it is in no danger of spoiling before delivery to the market, where it can again be iced.

Seafood is not the only product to benefit from the new iceless package. A wide variety of other perishables has been successfully shipped in this manner, including deep-frozen turkey that arrived in Guatemala in perfect condition after a 51-hour trip from New York State.

Like air freight, the frozen-food industry is demanding new and better containers from package engineers. Existing wraps are not completely satisfactory because many of them permit "freezer burn"—the dehydration of frozen food when it is kept any length of time in a storage cabinet. The cold air in the cabinet is so dry that the natural moisture in the food, even though present as ice, actually evaporates. The solution to this problem seems certain to be the new materials that guard almost completely against moisture vapor. Tests already are being conducted of one package made entirely from heavy-gauge aluminum foil that transmits practically no moisture vapor.

For home freezing, Pliofilm bags have been used. They, too, are highly vaporproof, and can be sealed easily with heat from an ordinary flatiron.

All these new packages, whether designed for frozen peas or hypodermic needles, are intended to get the product from the manufacturer to the consumer more economically.

If the cost is greater, the rise must be justified by a more useful package. Typical of expensive containers worth extra money are the reusable packages popular just before the war. Now one electrical appliance manufacturer plans to bag all his washing machines in transparent plastic film. When the washer is sold, the wrapper goes with it to serve as a removable dust cover.

But most packaging research is aimed at reducing costs. Long strides have been made recently in this direction with paper, one of the cheapest of all materials. Methods developed during the past few years give paper practically any desired quality (PSM, Sept. '46, p. 75).

Cheap or expensive, the postwar package seems certain to be quite different from the wooden crates and barrels that only 50 years ago transported almost all goods—different and a whole lot better. END

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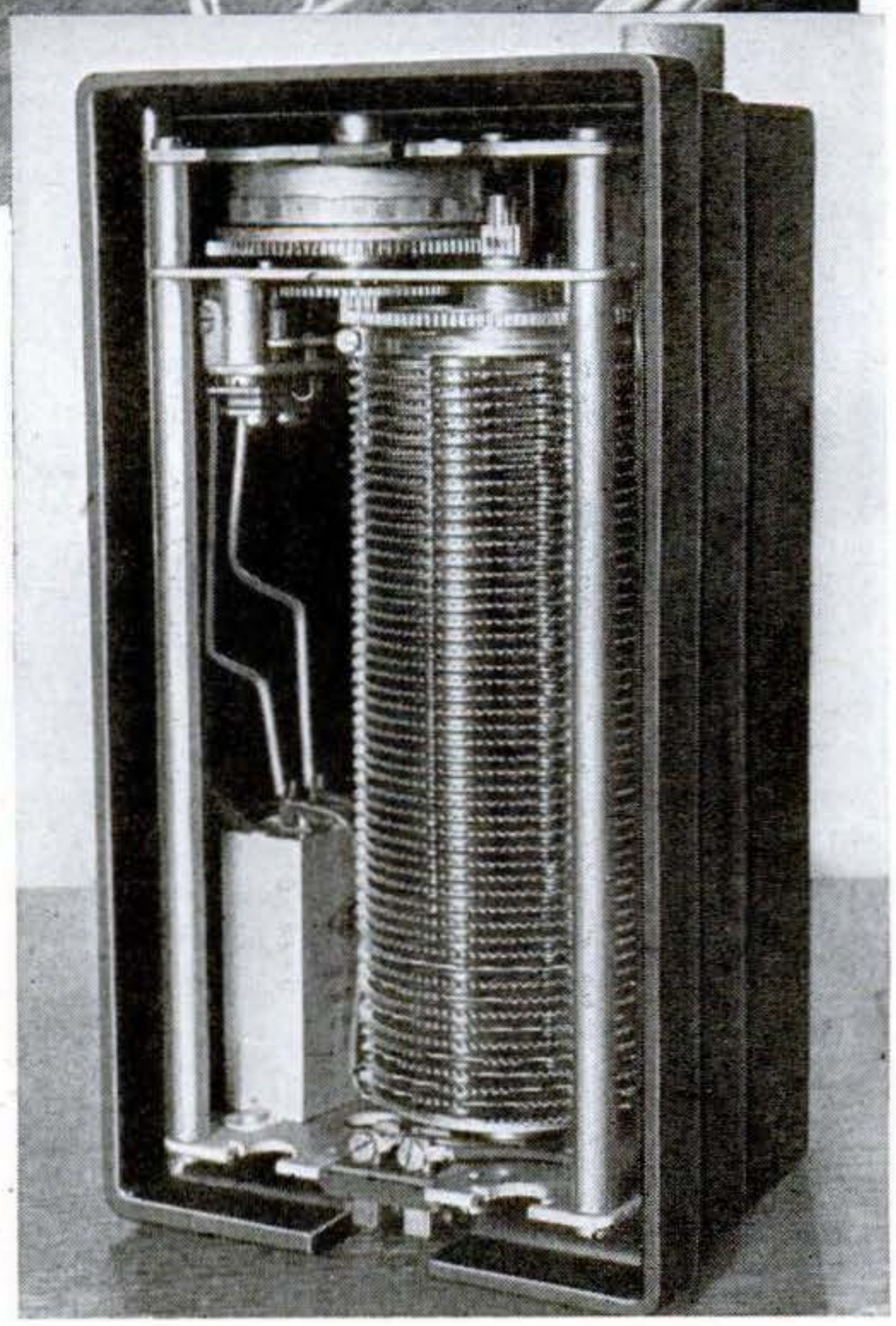
Directory Dials the Phone

Above, the Auto Dial beside a telephone; phantom finger is pushing the lever that compresses the power spring. Knob at the top has already been moved opposite desired number, aligning telephone-circuit contact with a brass disk inside case.

A NEW desk telephone directory not only finds the number you want but actually dials it for you. All you have to do is slide the knob on the face of the device, called an Auto Dial, to the name you want, then press the small lever at the foot of the machine. When the lever returns to its normal position, in five or six seconds, your call is made and you pick up the phone.

The Auto Dial was invented by a German before the war. The only sample in this country is owned by Alfred Altman, President of the National Dairymen Association. The machine can handle any 50 telephone numbers desired by the user, and changes can be made at will.

The signals can be made up of any number of letters and digits, according to the system used in the local exchange. The regular hand dial on the telephone can be used in the ordinary way when the automatic device has been attached.



Underside of Auto Dial. Teeth on each disk in column at right have been clipped to reproduce code of one telephone number. After sliding knob has brought the appropriate disk into circuit, a spring in the bell-like case at top drives gear, revolving column one turn. Teeth of the disk selected create electrical impulses that dial number.

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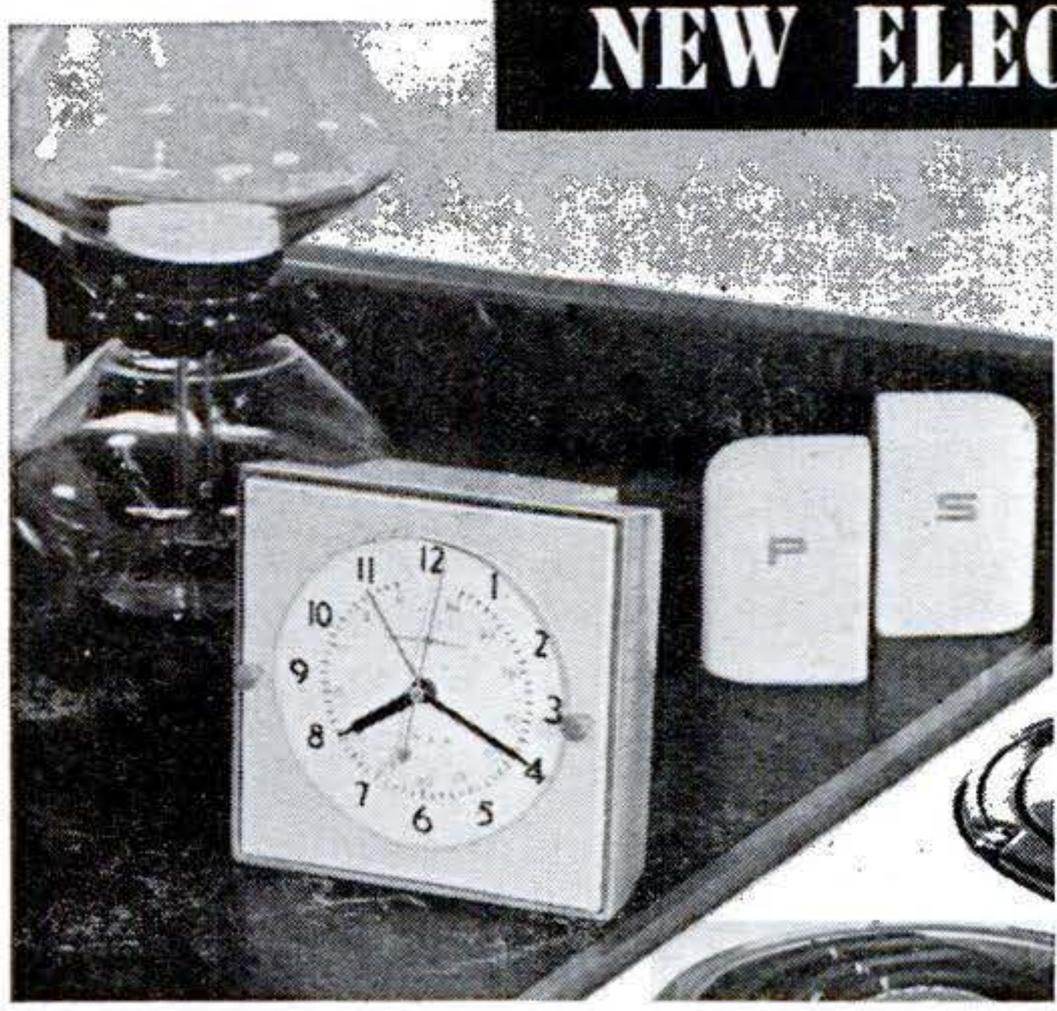
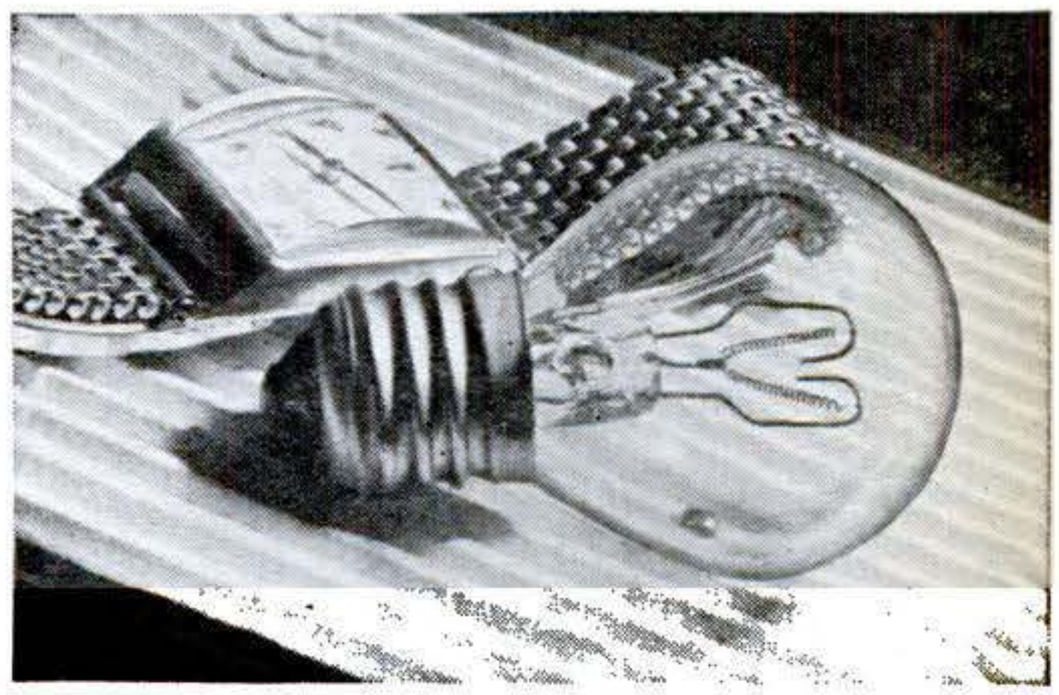
Roaster for Amateurs. Fowl up to six pounds and cuts of meat up to 10 can be roasted to an epicure's taste by an amateur in the Rotiss-O-Mat. Basting and turning are unnecessary. The meat has only to be spitted on a stainless steel skewer, fixed at one end by a holder to prevent slipping, and placed in the electric roaster. A motor turns the meat about three times a minute and a Nichrome element on the lid supplies the heat. A six-pound chicken takes about one hour and 20 minutes to cook. The Rotiss-O-Mat weighs 13 pounds, has a Bakelite handle and heat-resistant glass sides, and can be put right on the dinner table.

NEW ELECTRICAL APPLIANCES

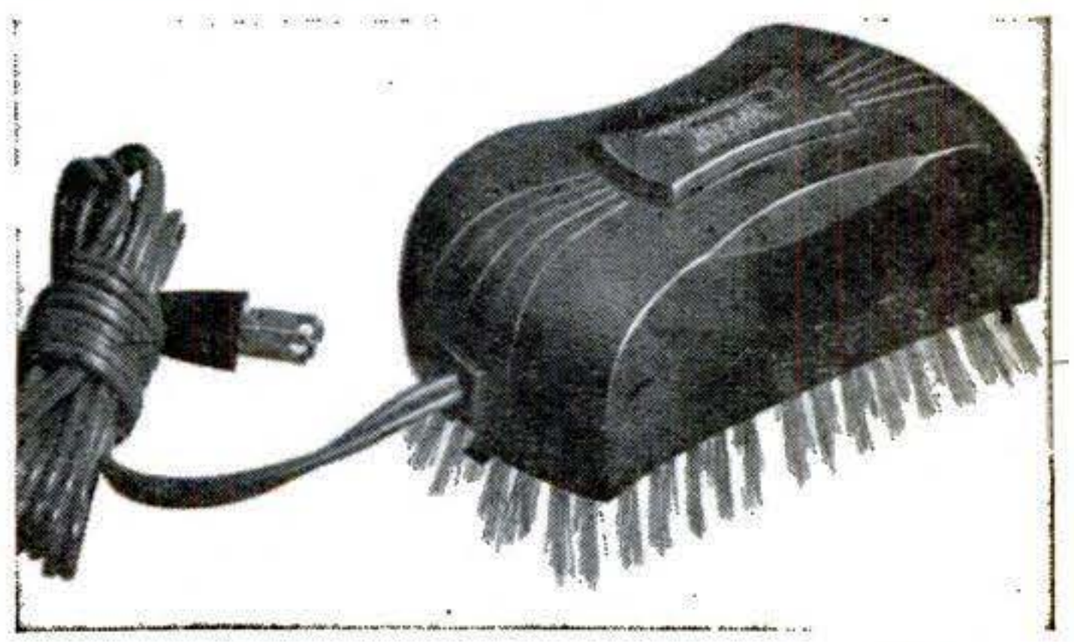


Kitchen Reminder. For the harassed or absent-minded housewife the Chef, an electric alarm clock that can be set to buzz on the second, will guard against overdone food and jangled nerves. It allows her to leave the cooking for other tasks knowing that the alarm will warn her when the three-minute eggs, or the roast, are done. The right-hand knob sets the buzzer, the left one regulates the hour and minute hands. The plastic timer can be attached to the wall or placed on a flat surface. It is made by General Electric.

Midget Germ Killer. No bigger than a walnut, a new ultraviolet-ray lamp has been designed by Westinghouse to kill bacteria and reduce food odors in refrigerators. It is the first ultraviolet germ killer made in other than a tubular shape. Named Sterilamp, it costs about five cents a month to operate and burns only when the refrigerator is running. It sells for $1.60 and will last a year.



Brush Massager. Nylon bristles not only brush the hair but massage the scalp in the Gyra electric hairbrush. A plastic case houses a tiny motor that transmits a rotary action through a rubber gasket. The motion is picked up by the brush plate, which in turn causes the individual bristles to vibrate. For cleaning, the bristles can be removed by unsnapping two spring clips. The brush runs on AC or DC current.



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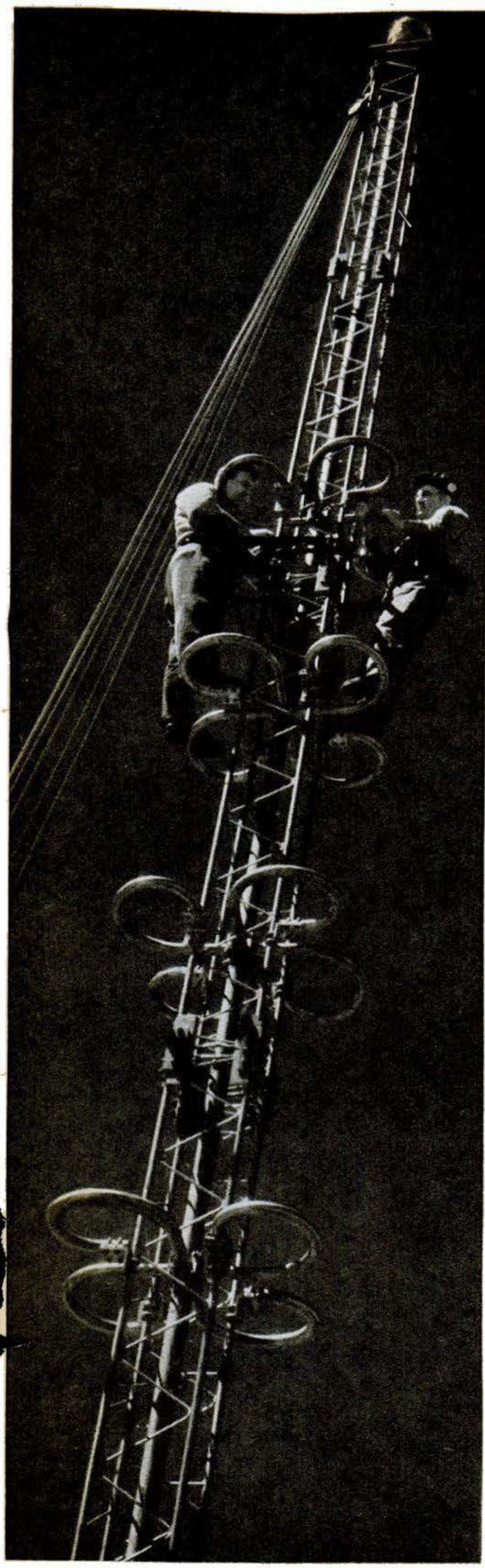

You'll Hear from

A clover-leaf FM antenna at the Bell Telephone Laboratories in Whippany, N. J., is shown at left. Built by Western Electric, it is 50 feet high.

By WILLIAM P. VOGEL, JR.

AMERICANS will hear more from FM in 1947 than ever before. FM—frequency modulation—had more than 500,000 converts to staticless, noiseless, high-fidelity reception when manufacturing of sets was frozen in '42. By V-J Day more than $500,000,000 worth of FM equipment was at the fighting fronts, and now commercial broadcasters, long hesitant about FM, have perked up.

By last summer the applications to build FM broadcasting stations exceeded the number of AM stations on the air when the war ended. As materials become available and manufacturers' wheels turn, enough FM equipment to revolutionize U. S. radio can be poured out.

FM will not be cheap. FM completely blanks out man-made and natural static—if the circuit is properly designed and built. FM has an audible range of 30 to 15,000 cycles without distortion—if it is fed into a high-fidelity amplifier and well-baffled loudspeaker. But these components are expensive. The best guess in the trade is that you will have to pay $350 to $400 for the best kind of FM, with AM and short-wave receiver, plus an automatic phonograph record-changer. Prices may come down later, possibly to around $275 without phonograph equipment. And as they drop they will undoubtedly change the whole nature of radio-set buying.

FM will create a secondhand market in radios just as the automobile industry created a used-car market. A good FM set, after a few years of use, still would have plenty of life left and could be sold for half price. FM enthusiasts are counting on the growth of a secondhand market to put more receivers into the hands of the public.

"Why should I," you ask, "sink so much money into an FM set to get high notes when I always turn down the tone on my

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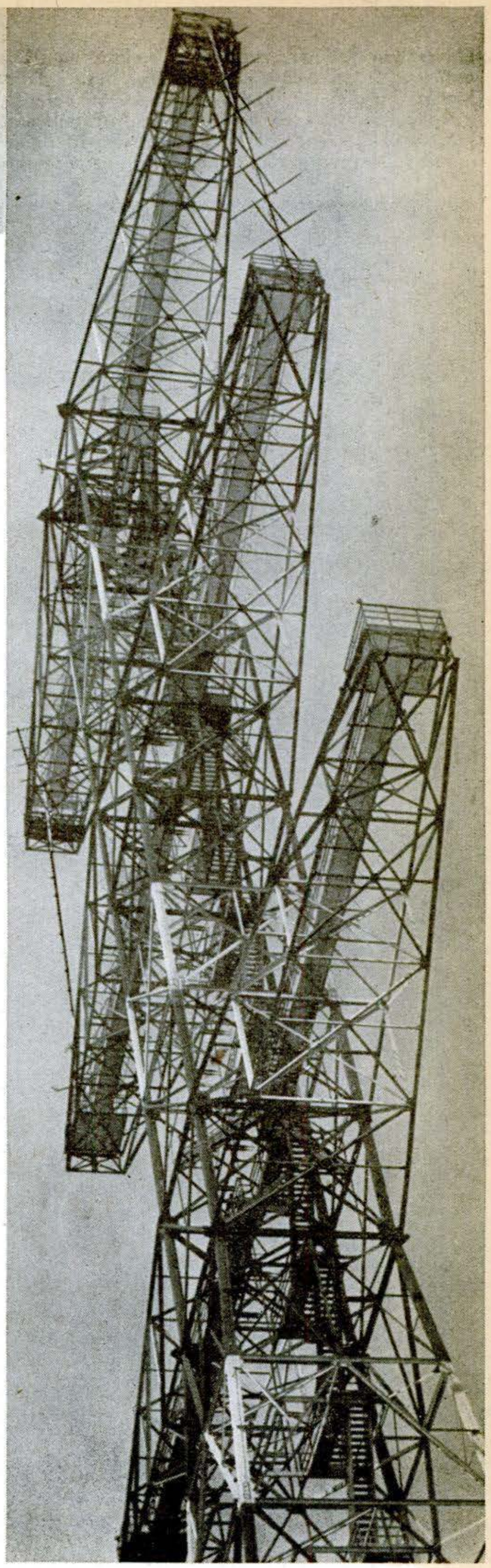
FM in '47



Oldest of all FM antennas is W2XMN's tower at right. It was built by Maj. Edwin H. Armstrong, inventor of FM, at Alpine, N. J.; first used in 1939.

AM radio because I don't like high notes?"

Radio engineers answer that you never have really heard high notes over a radio until you have heard them over an FM radio. Maj. Edwin H. Armstrong, who invented FM, says AM inherently distorts sounds through a process known as cross modulation. That is why, he adds, ordinary sets sound like radios and FM sets sound like musical instruments.

The technical difference between AM and FM is in the way the wave is changed. In AM the power of the wave is changed in proportion to the power of the sound wave to be transmitted, but the frequency never changes. It is like a searchlight transmitting messages from ship to ship. A shutter changes the intensity of the light (its power varies) but its color remains the same (the frequency never changes). In FM the frequency is varied but not the power. In this case the searchlight would have no shutter (constant power) but messages would be transmitted by changing the color of the light from red to blue to yellow to violet to green (varied frequency).

FM is inherently a better method of broadcasting. It works through the worst thunderstorm or next to a powerful electric generator. FM, in fact, has often been said to be the only way to broadcast silence. It has high selectivity and completely blanks out everything except the desired station; reception never fades, because the strength of the signal is constant.

A greater variety of programs will eventually be broadcast by FM. Stations operated by companies that own AM stations may simply rebroadcast the usual network fare. But the Federal Communications Commission has many applications for FM stations to serve special listening groups. In New York, several FM stations already are serving up a steady flow of special features.

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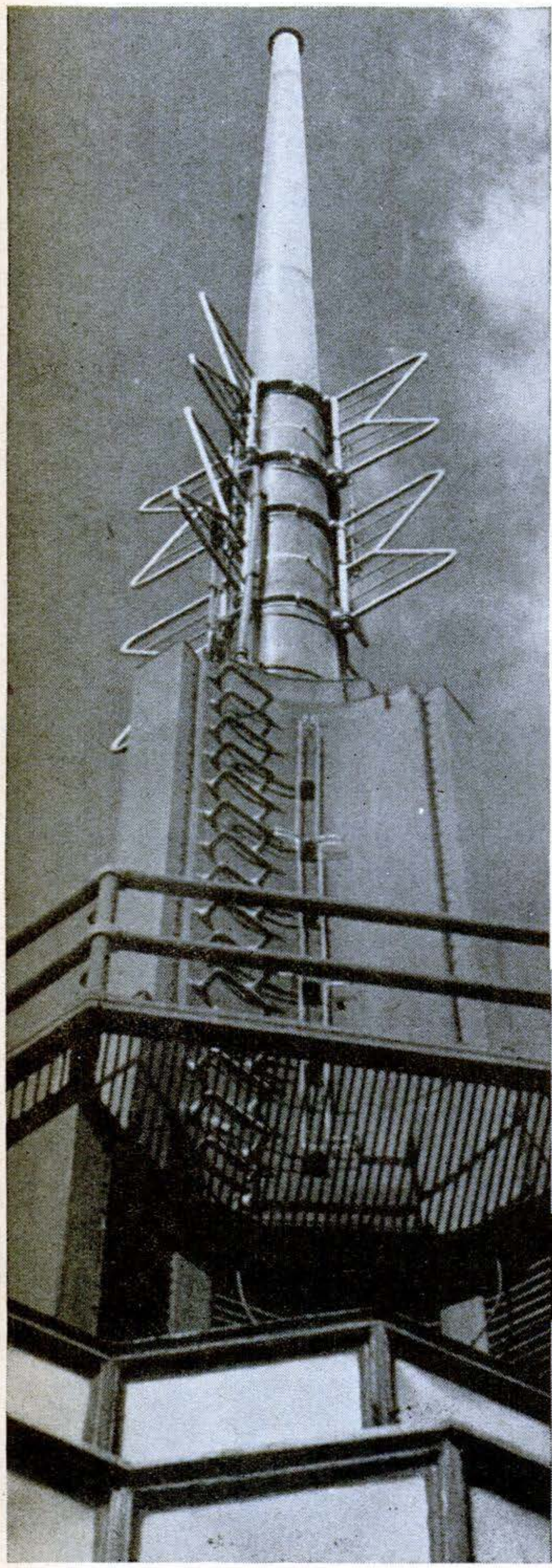
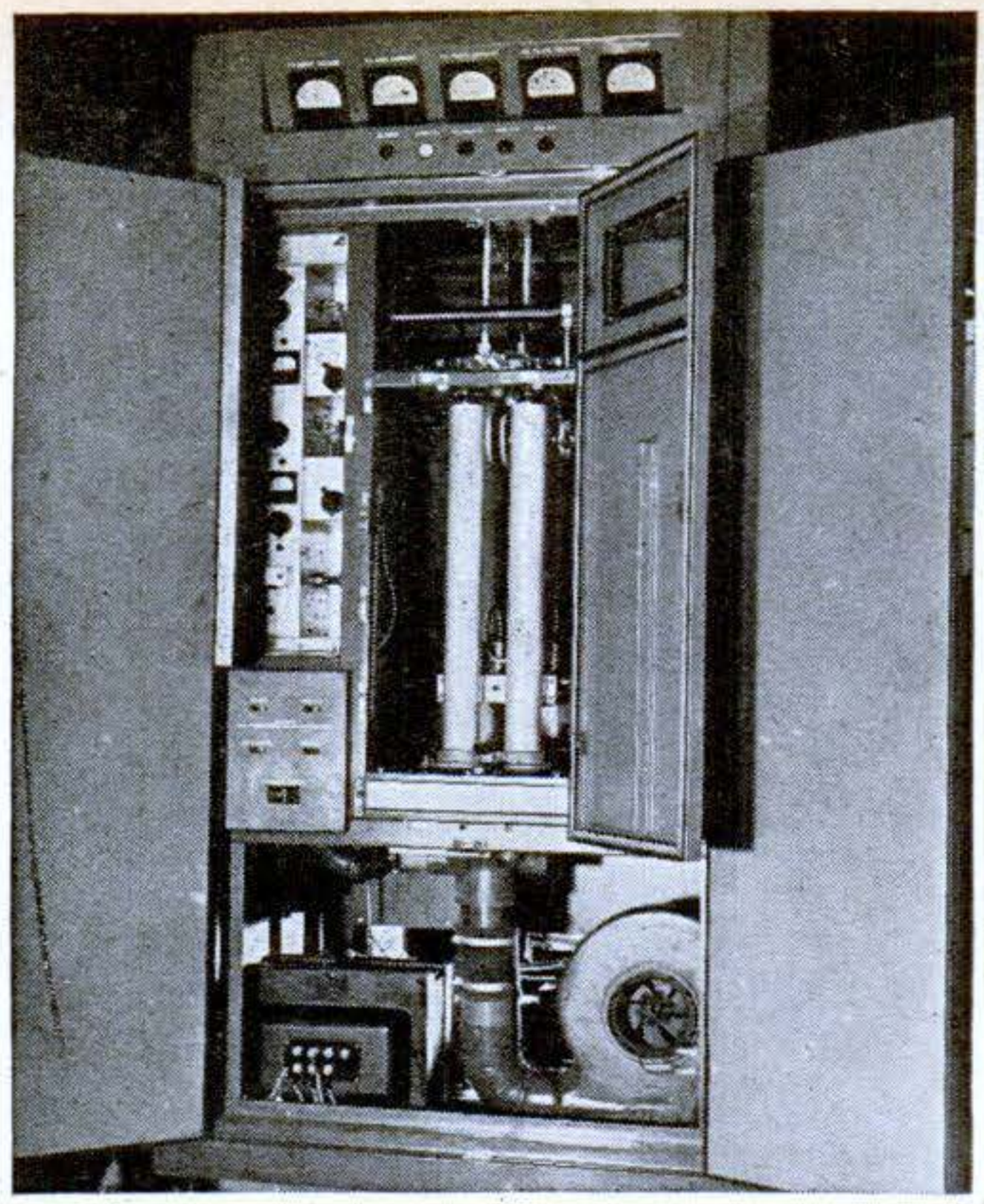
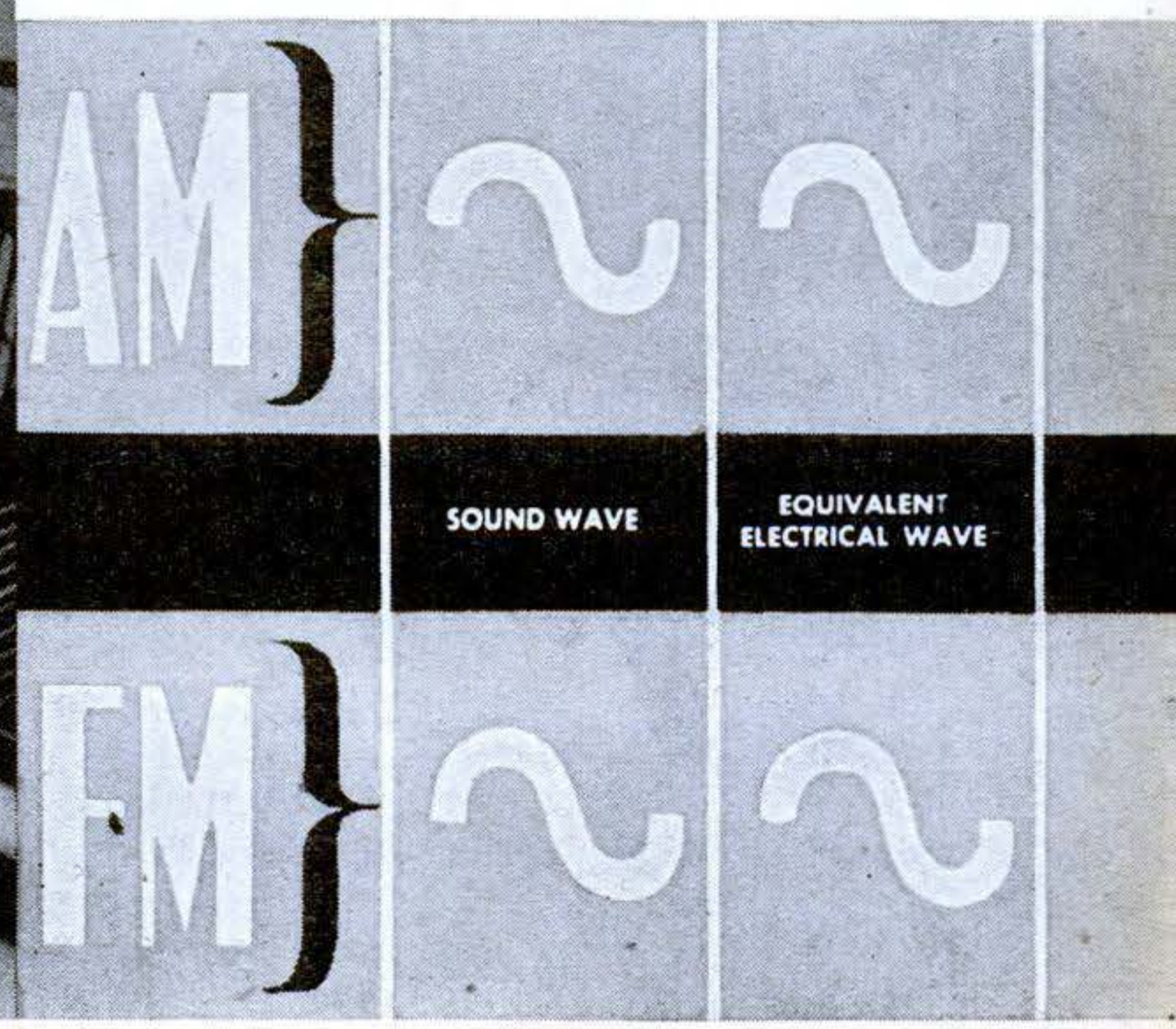
FM station WYGN's superturnstile, batwing RCA antenna, shown below, sits atop the world's third highest building, in New York City. The antenna can simultaneously transmit television, facsimile and FM. It is 950 feet above sea level and its signal covers 9,000 square miles. It has de-icing equipment.





Plug in on power, hook onto an antenna and the REL one-kw. FM transmitter (above) is on the air. It is typical of the new packaged units.

The difference in AM and FM radio transmission is illustrated in the diagram below. Static impulses are of essentially the same character as AM impulses; it is impossible for an AM receiver to distinguish between the two, so the loudspeaker emits both. FM eliminates static by transmitting impulses of a different character. Diagram shows how in FM transmission the sound wave's electrical twin rides inside the carrier wave. Static rarely penetrates the envelope thrown around the FM impulse. When FM receiver strips off carrier envelope, the sound wave comes out clean and clear.



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FM fans in the East this year will probably have a good 30 stations to pick from. In a few years the whole country will get network coverage. FM stations that now rebroadcast AM programs eventually will have to hatch new ideas. The FCC may order in 1947 that at least two hours a day be devoted to independent FM programming.

FM ties in well with television. The sound accompanying television pictures is broadcast on FM. Television and FM, moreover, use the same type of antenna: simple dipoles placed as high as possible, the crossarms set broadside to the direction of the transmitters. If you live near a powerful FM station you probably can get by with a loop antenna inside the house, but your selection of stations will be cut down.

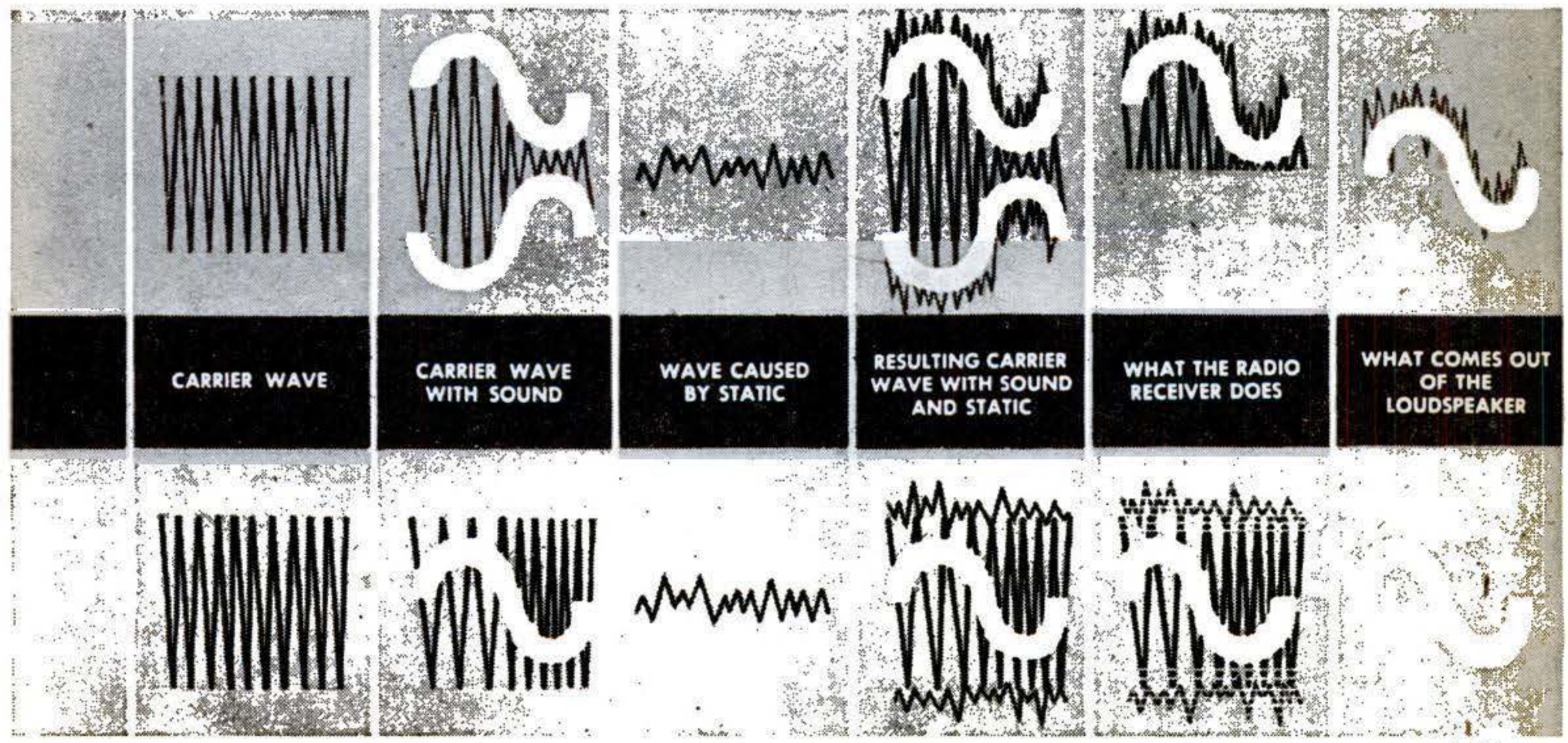
Another running mate of FM is facsimile. About a dozen stations broadcasting printed newspapers and other programs are already operating or being tested in various parts of the country. As high-frequency transmission of text and pictures is developed, the FCC will probably allow "multiplex" transmission—simultaneous sending of entertainment and facsimile (PSM, Nov. '46, p. 86). While you listen to your FM program, your FX printer will produce a newspaper for you to read—or the program could be supplemented simultaneously by facsimile pictures, maps or diagrams.

FM has had a rugged childhood. It was consistently cold-shouldered by the big radio networks—they feared it might upset their well-built applecarts. After the war, the FCC ordered FM's frequency band changed from 42-50 to 88-108 megacycles —a new region of the radio spectrum unexplored until its use during the war—and it took set and equipment makers a year to perfect vacuum tubes and circuits to deliver high power in the new band. Only 500 sets a day were being turned out last June, but about three times that many were made in October.

Now, if you want to build an FM station, you can buy a completely packaged transmitter of from one to 10 kilowatts. Later this year you will be able to get bigger ones, 25 to 50 kw., and little 250-watters, for use in rural communities.

Some enthusiasts predict that in three to five years FM will have replaced AM broadcasting, except for a few clear-channel stations serving certain areas. The reasons are technical and economic. The AM band, with more than 900 stations, is congested. Stations on the same frequency interfere with each other. Many cities and regions can't have them because there simply isn't room enough on the air. But there is plenty where FM lives. The power of FM stations can be controlled so that each station covers only a special service area. Besides, FM broadcasts on adjacent frequencies do not overlap. It appears from scientific studies that 5,000 FM stations can be comfortably housed in the 88-108 megacycle band, each operating on the ample band width of 200 kilocycles.

Thus, FM makes it possible for all kinds of groups to provide programs for all kinds of listeners. A farm organization in the Dakotas could blanket its area with farm



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programs without interfering with a labor union in Pittsburgh. A church in Salt Lake City could offer religious programs without interfering with the San Francisco Board of Education.

Major Armstrong got on the track of FM in 1924, after radio experts had given up hope of licking static. They recognized that static was essentially just what an AM signal was, and they never could disentangle the two. Their only recourse was to pass an ever-narrower AM band into the receiver and to increase the power of AM transmitters. Armstrong saw that a different kind of wave was needed.

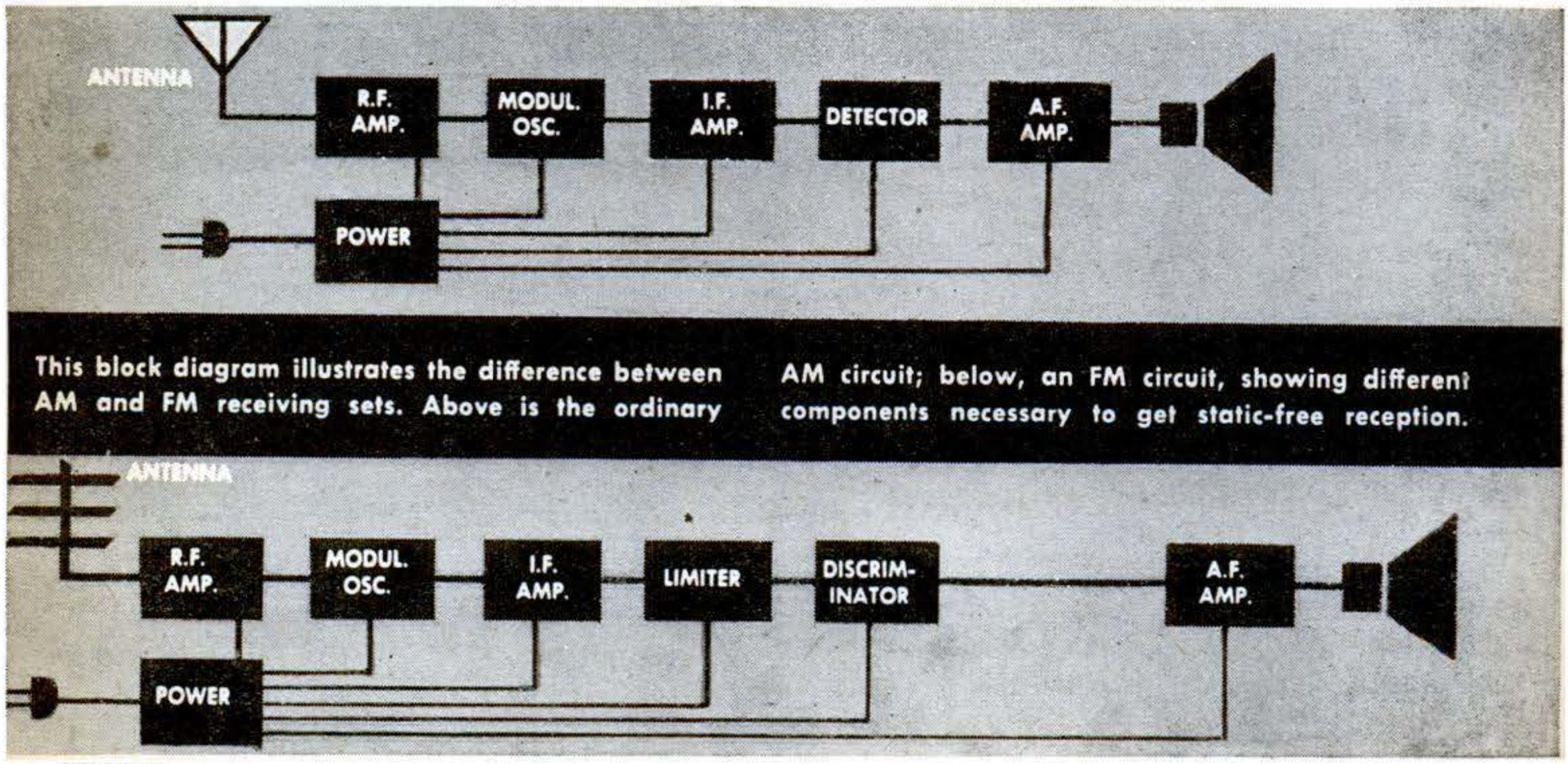
He was a professor of electrical engineering at Columbia University, trained by the great Michael Pupin. He had invented three basic radio circuits—the regenerative, superregenerative and superheterodyne. But, to conquer static, he discarded mathematical equations in favor of physical concepts. Instead of trying to narrow the band width he deliberately widened it. And to impress music or speech on his wave, he fixed on frequency modulation, an idea at which experts had long sneered. They believed it would keep out high frequencies and produce unbearable distortion.

By 1933 Armstrong was ready with wide-band FM. A year later his tests at two kilowatts on 44 megacycles convinced him that FM was a natural. He wrote in his log: "An era as new and distinct in the radio art as that of regeneration is now upon us." But he was snooted by the industry. If Armstrong had been a poor man, FM might have been squelched, but he was able to spend more than $500,000 on the further development of FM. He built his own station, W2XMN, in Alpine, N. J., to prove FM was as good as he said it was.

The Alpine station started test broadcasts in 1939. It proved Armstrong's claims. The next year FM was granted commercial status at 42-50 megacycles. Independents and AM station owners began to put in FM transmitters. With those who heard it, FM caught on at once. It was stable; it was cheap to install and operate. To certain parts of the country, such as New England, where AM reception was poor because of the rocky terrain, FM was a boon. Embryo FM networks using radio-relay links set the pattern for expansion. State police organizations took over FM and successfully used it in their work. The Army Signal Corps subjected FM to grueling tests and found it far superior to AM for military communications.

FM should have been all set to go when the war ended. But the strange politics of radio boxed it in. Last May, FCC Commissioner Clifford J. Durr, FM's leading official sponsor, said: "Conditions could not be more ideal for launching a new service. But there seems to be a disturbing inclination on the part of radio to cling to its old system of aural broadcasting, rather than to give free rein to a new system. The new system is admittedly superior, but it means newcomers and, hence, new competition."

The Commissioner may have awakened the radio industry, for FM is now humming and seems likely to be the star of this year's radio show. END



This block diagram illustrates the difference between AM and FM receiving sets. Above is the ordinary AM circuit; below, an FM circuit, showing different components necessary to get static-free reception.

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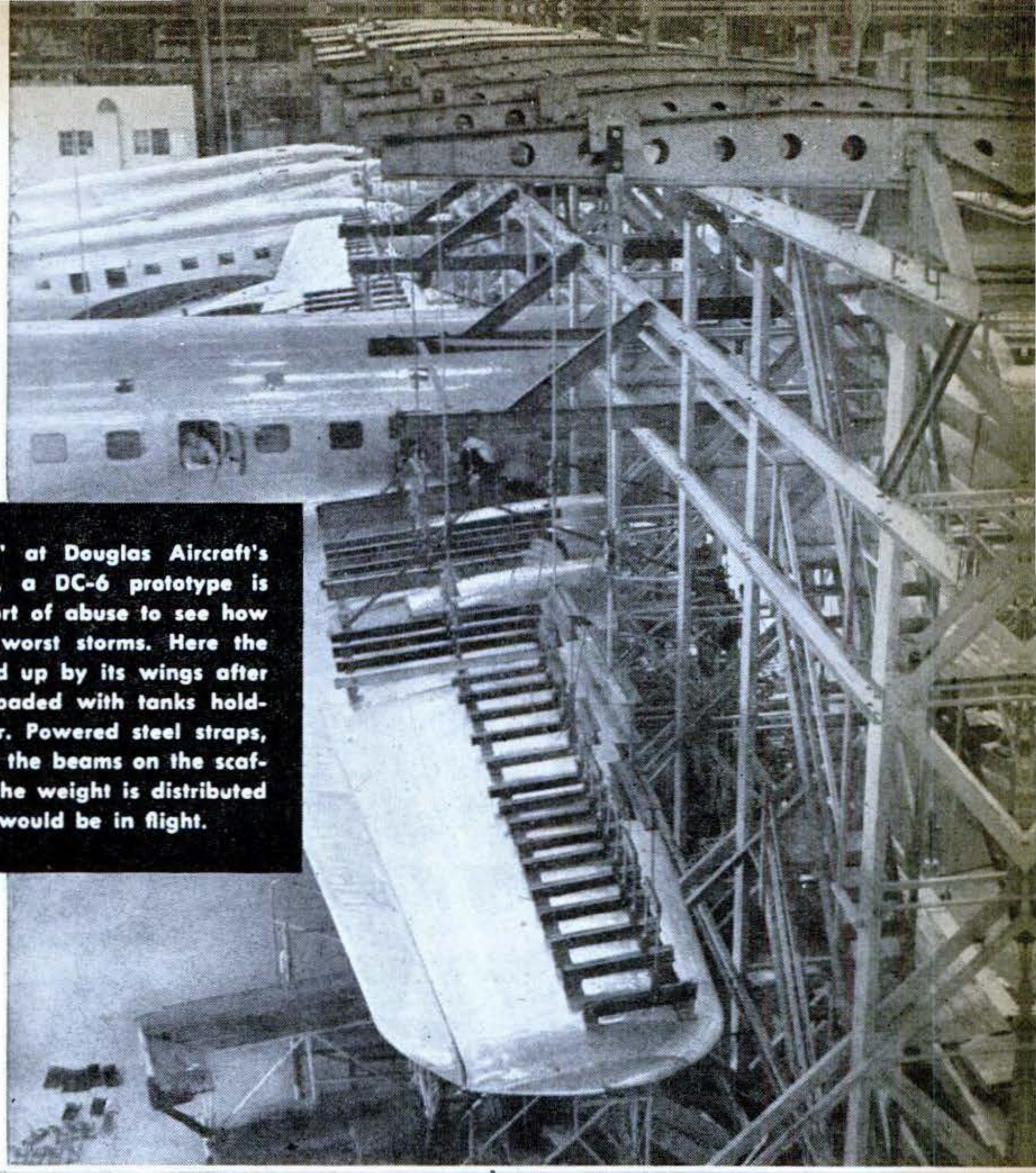
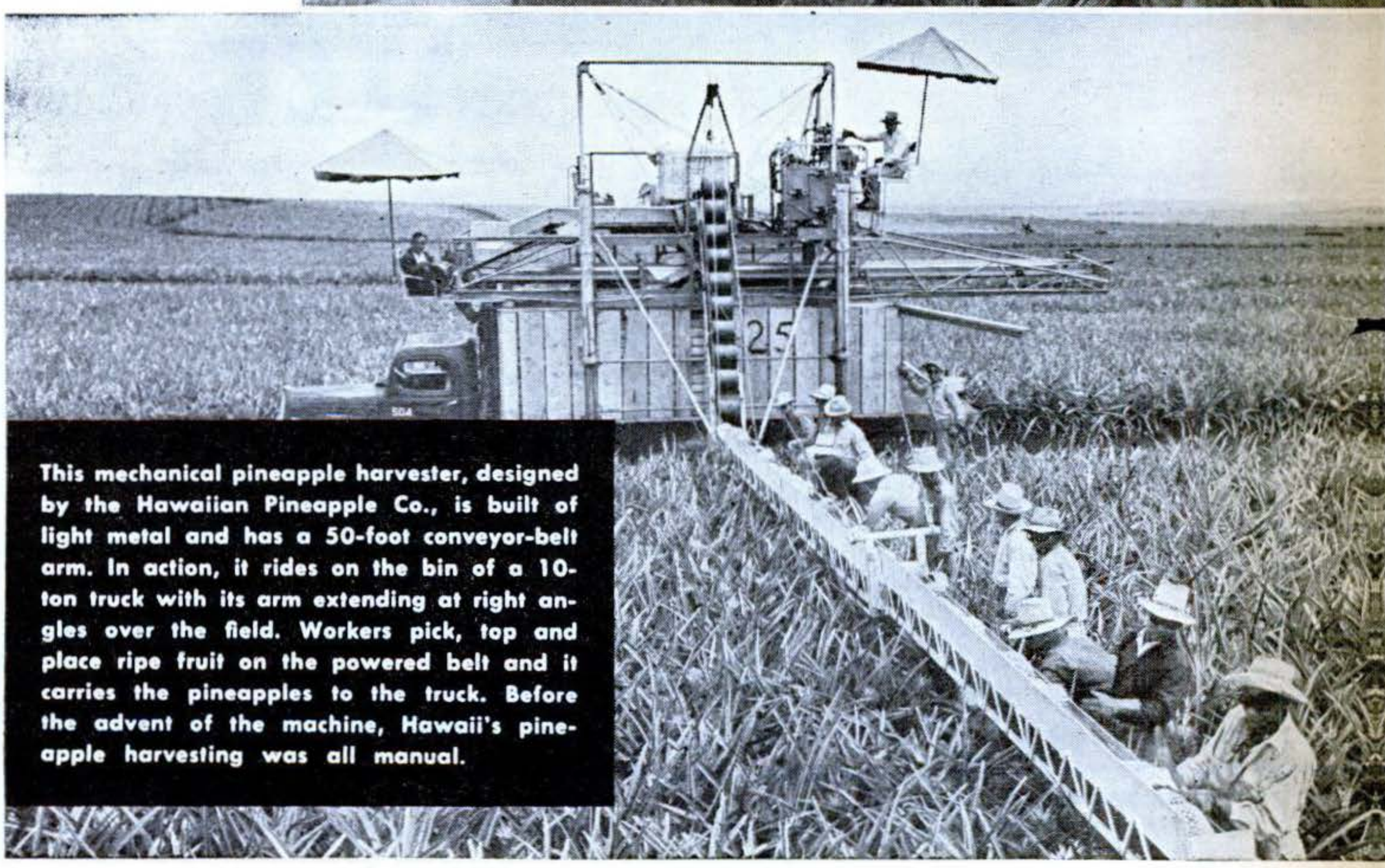


On a "torture rack" at Douglas Aircraft's Santa Monica plant, a DC-6 prototype is subjected to every sort of abuse to see how it will weather the worst storms. Here the plane is being picked up by its wings after its cabin has been loaded with tanks holding 25 tons of water. Powered steel straps, extending down from the beams on the scaffold, do the lifting. The weight is distributed over the wings as it would be in flight.



This mechanical pineapple harvester, designed by the Hawaiian Pineapple Co., is built of light metal and has a 50-foot conveyor-belt arm. In action, it rides on the bin of a 10-ton truck with its arm extending at right angles over the field. Workers pick, top and place ripe fruit on the powered belt and it carries the pineapples to the truck. Before the advent of the machine, Hawaii's pineapple harvesting was all manual.

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Mechanics of LIVING

METER INDEX COUNTS THE NUTATIONS (WOBBLES)* OF THE DISK AND CONVERTS THE NUMBER INTO A READING IN CUBIC FEET

REDUCTION GEAR TRAIN DRIVEN BY SPIDER SHAFT

OUTLET DUCT FROM MEASURING CHAMBER

SPINDLE

WOBBLING OF DISK CAUSES SPINDLE END TO CIRCLE, TURNING THIS SPIDER AND ITS SHAFT

WATER SUPPLY PIPE

WATER OUTLET PIPE

THIN WALL SEPARATING INLET AND OUTLET OPENINGS OF CHAMBER

MEASURING DISK (DOES NOT ROTATE IN WATER FLOW, BUT WOBBLES)

MEASURING CHAMBER

SLOT HOLDS SEPARATING WALL

SPINDLE

MEASURING DISK

WALL SEPARATES INLET AND OUTLET

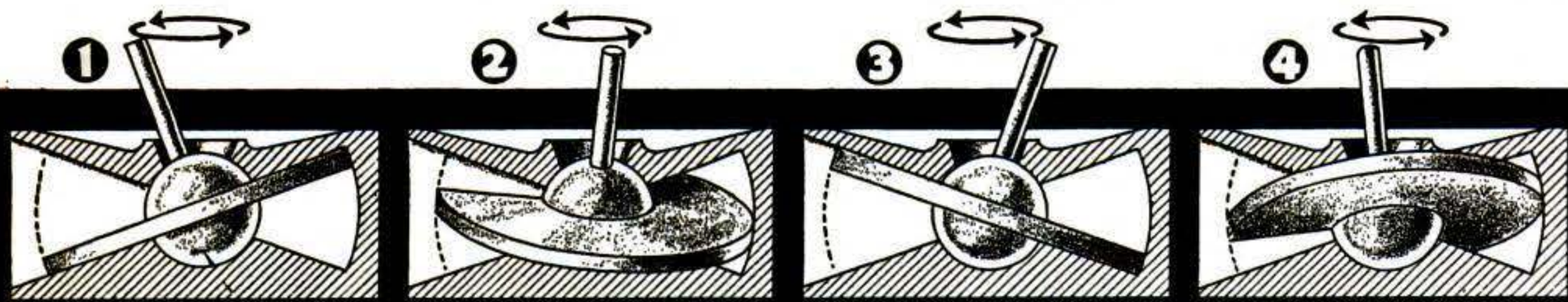
MEASURING CHAMBER

OUTLET

CHAMBER INLET

WATER CIRCLES CHAMBER

HOW WATER and



HOW ONE NUTATION OF MEASURING DISK CAUSES ONE ROTATION OF SPINDLE END

Cutaway at top of page shows how a disk-type water meter works. Water enters meter at right and flows around gears to entrance, at left, into measuring chamber. There it wobbles the top-like disk and leaves chamber at exit behind, but separated from, the entrance. The wobbles of the disk spindle engage the teeth of shaft above and rotate it. Gears carry the rotation to top of meter, where turns are recorded in cubic feet on face dials. Inset shows details of measuring chamber and disk.

Diagrams just above explain disk action: (1) water enters at left and fills space above tilted disk; (2) pressure of water above disk tilts it toward the reader, lifting edge at intake so that water enters beneath disk; (3) pressure beneath disk now forces edge upward at intake, while water above disk continues toward exit; (4) pressure beneath disk tilts it away from reader, and water above disk escapes. At the same time, more water enters to restart cycle. Disk-spindle tip has made complete circle.

WATER ↑

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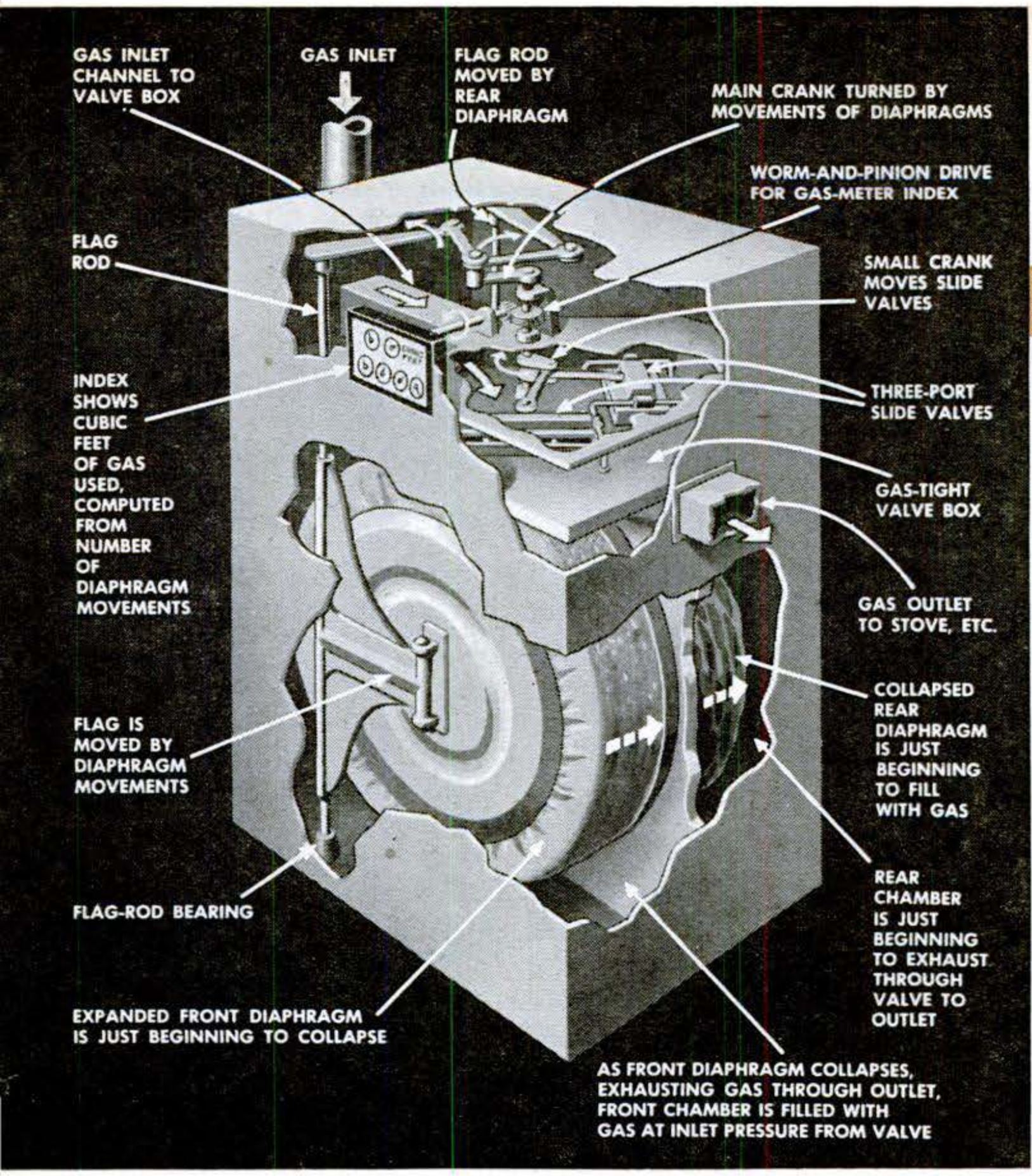
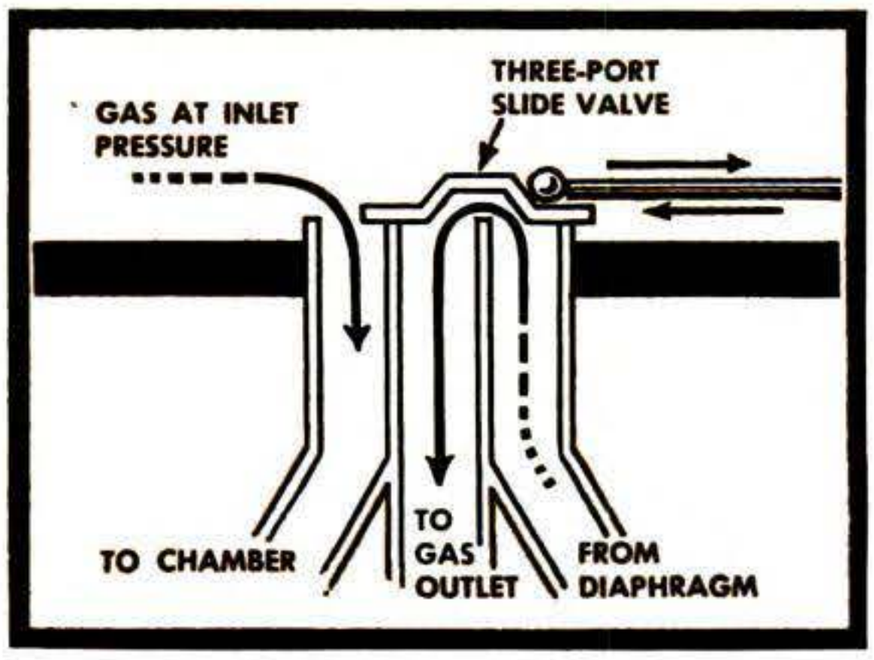


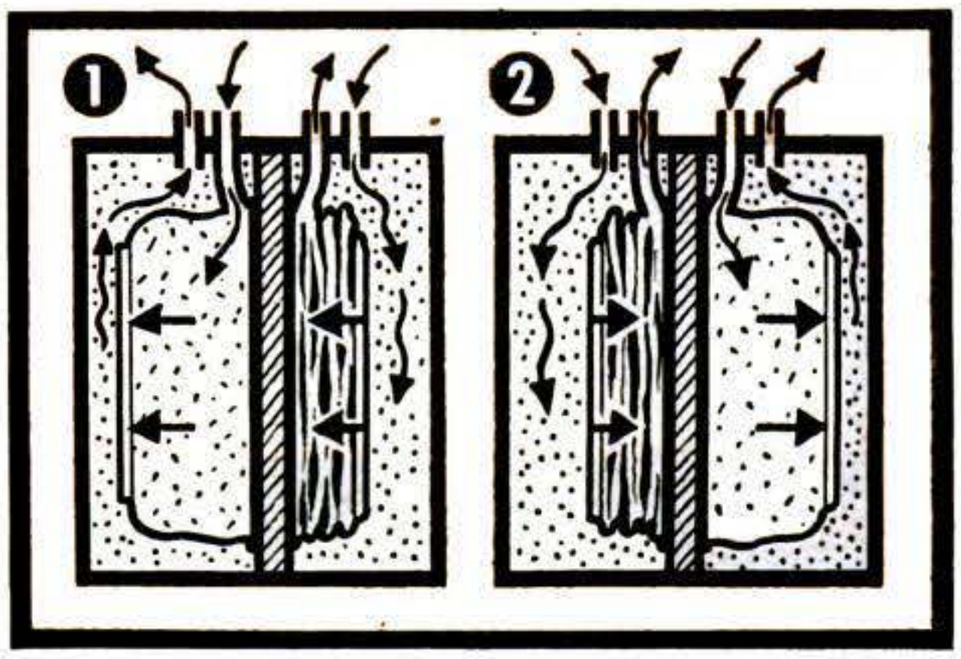
GAS

Today's gas meter works on essentially the same principle as first one built in U. S. in 1832. Gas enters through rear pipe and pressure forces it through valve box into lunglike leather diaphragm. As gas inflates the diaphragm it pushes out lever attached to its side, rotating a rod. A gear train carries turn of rod to dials, and at the same time changes the valve so that gas leaves lung for outlet, while more gas enters chamber around lung. Two lung-and-chamber units are used. Meter shown is the standard Glover type of displacement dry meter. It is made in various sizes to measure volumes up to 17,500 cubic feet an hour.

AS ETERS ORK



How valves work: Here gas flows into chamber, while valve is pushed to right to allow gas to exhaust from lung to outlet. Rod at top right, activated by collapse of lung, will then push valve to left, allowing gas to leave chamber while fresh gas enters diaphragm.



Drawings show how lungs and chambers alternately fill and exhaust. In No. 1, left-hand lung is swelling as gas pours in, while chamber is exhausting contents to outlet; in right-hand unit the opposite is happening. No. 2 shows second part of cycle. Two units are used to make process continual.

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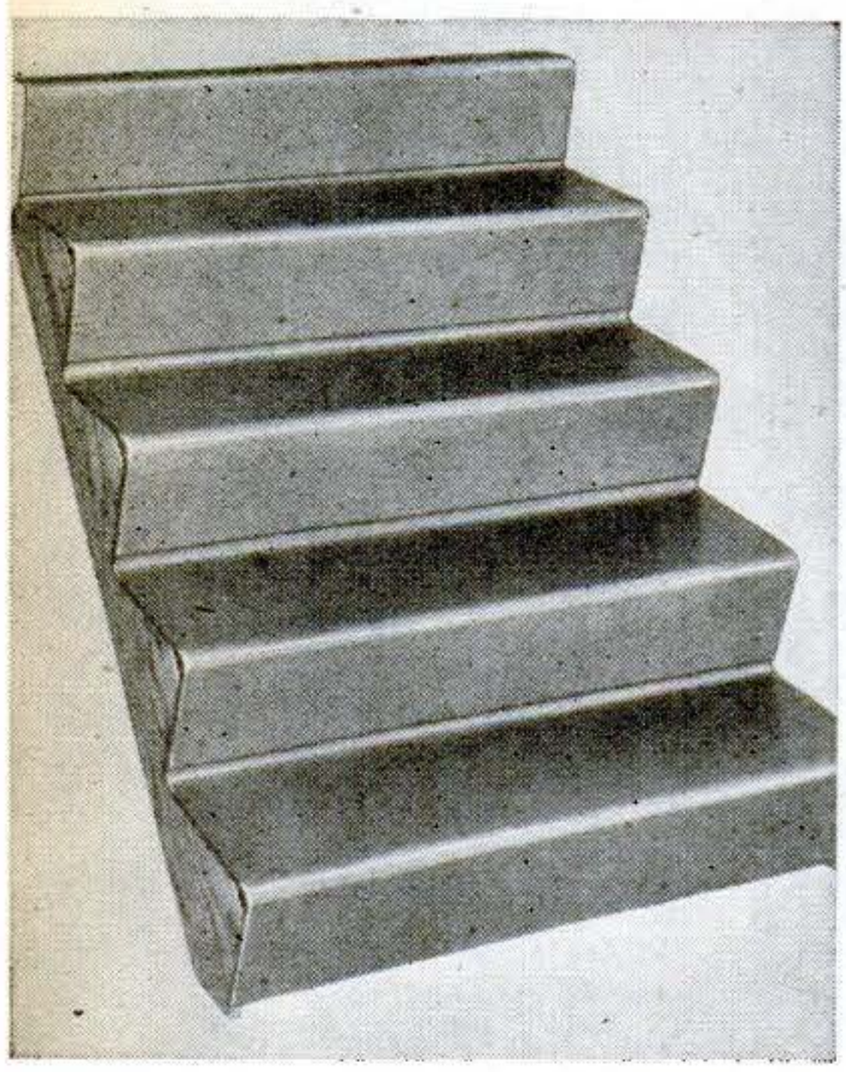
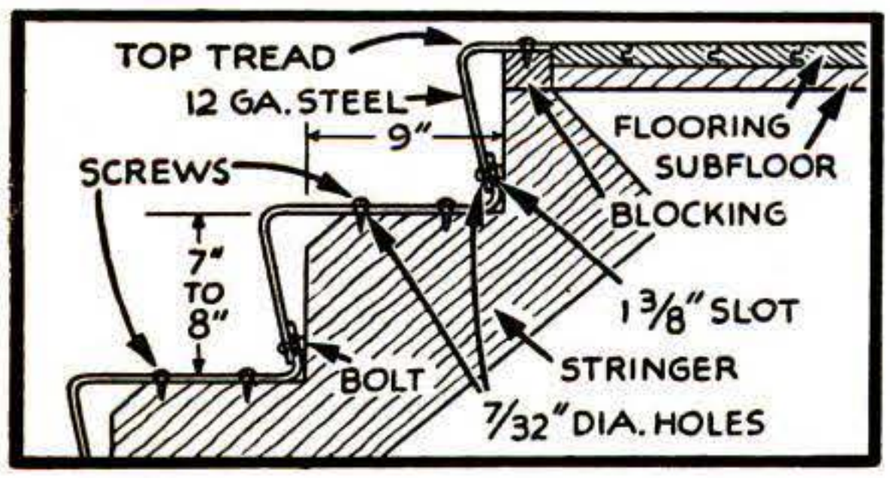
AIDS TO MODERN LIVING

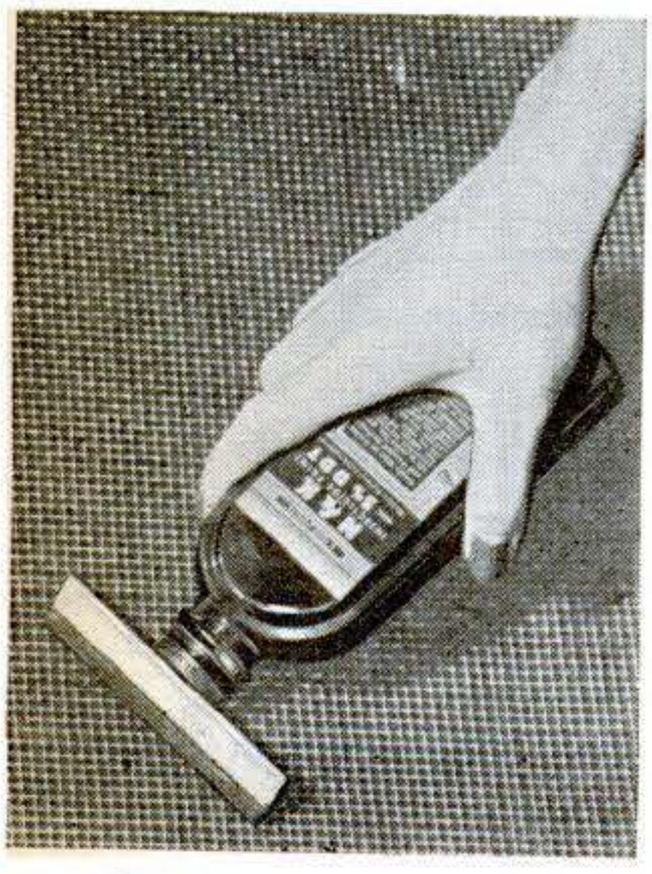


A WATERPROOFING CEMENT for brick walls, developed and put on the market by Martin and Milton Psaty, of Brooklyn, N. Y., is intended to protect interiors against peeling paint and plaster caused by seepage of moisture. Sold in powder form under the name of Brix-fix, the product is easily mixed and applied by the amateur.



SECTIONAL STAIR UNITS that combine tread and riser in one piece of steel are being produced by the Home Ola Corporation, of Chicago. Each unit is punched and slotted for screws and bolts, making it possible to assemble an entire stairway in about 90 min. A standard unit is 36″ wide with a net tread of 9″ and a 7½″ riser. The lip extending above the tread has a 1⅜″ slotted hole through which bolts secure the lower unit to the one above. This slot permits adjustment for the height of the rise to the extent of 1″ per unit, from 7″ to 8″.

APPLICATION OF D.D.T. to window screens can be accomplished with greater ease through use of an applicator manufactured by the Nash and Kinsella Laboratories, Inc., of St. Louis, Mo. The applicator has a screw top that fits any standard bottle of the insecticide. When the bottle is tilted in use, the insecticide pours into a nonrusting metal channel and saturates a felt material that spreads it evenly.



ONE TABLESPOONFUL of coffee, tea, or similar food substance is quickly and accurately measured by a device marketed by the Ammaco Products Company, of St. Paul, Minn. Known as the Ammaco Dispenser, it comes in two sizes for screwing on standard mason or coffee jars. In use, the jar is inverted and one movement of a lever releases an exact tablespoonful of coffee, tea, cocoa, baking powder, powdered soap, or similar material.

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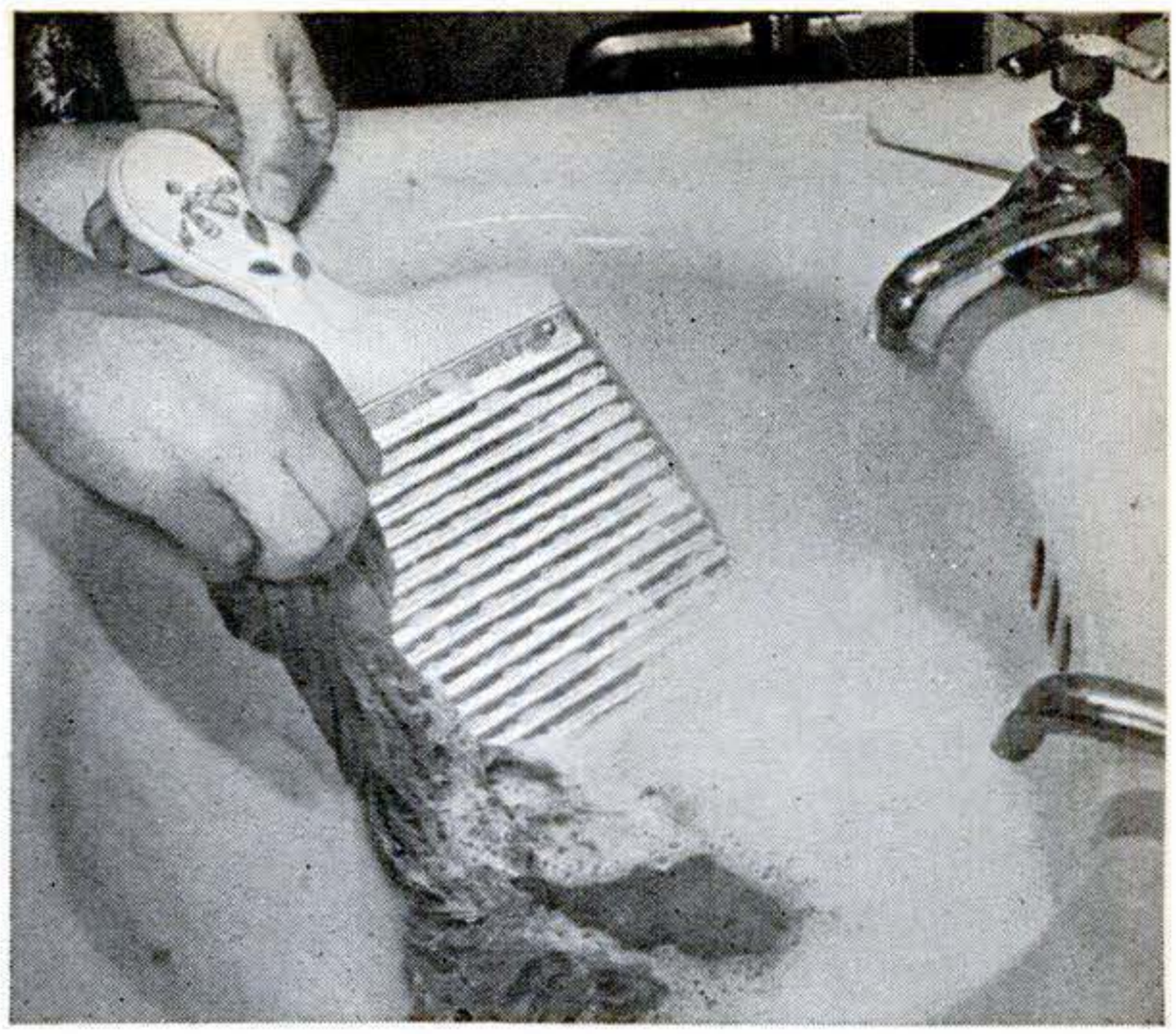
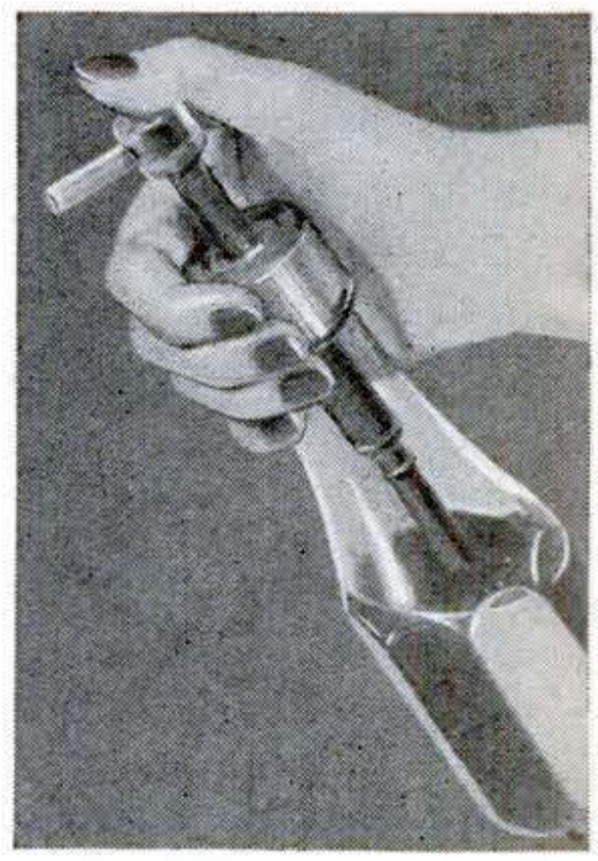
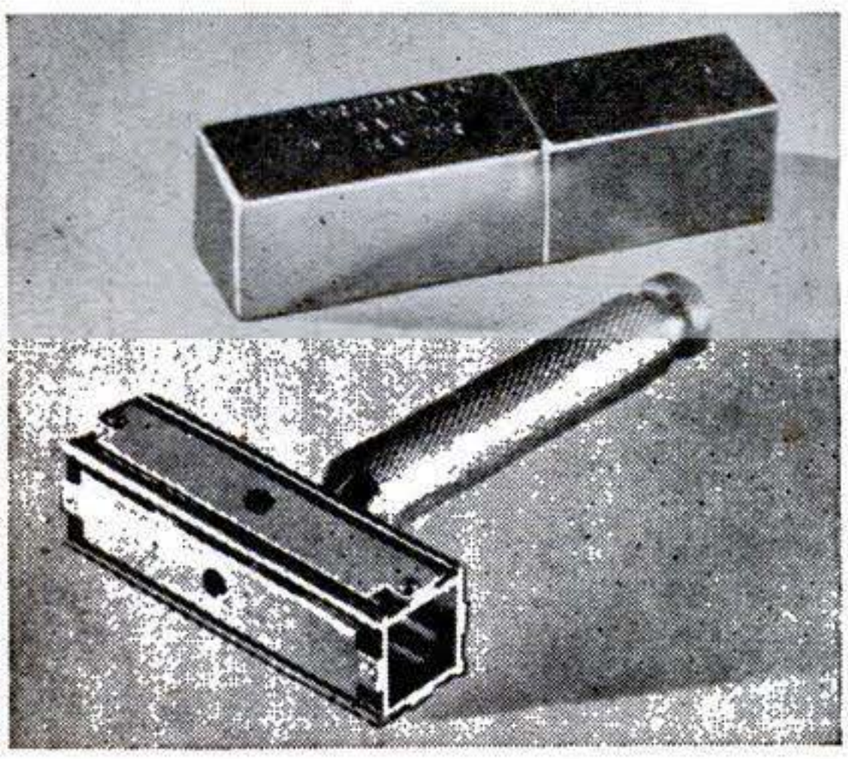
A HOME HUMIDIFIER made by the Modern Equipment Company, Bloomfield, N. J., is shown below. Water vapor that it produces is said to permeate the air completely in a moderate-sized space. It is portable and there is no installation problem since all that's needed is an electrical outlet.



DESIGNED TO FIT THE HAND, the sink-size washboard above is made of wood with an aluminum rubbing surface. In use, the curved handle is held with the left hand while the right scrubs stockings, lingerie, etc. The distributor is the Midwest Brokerage Company, Minneapolis, Minn.

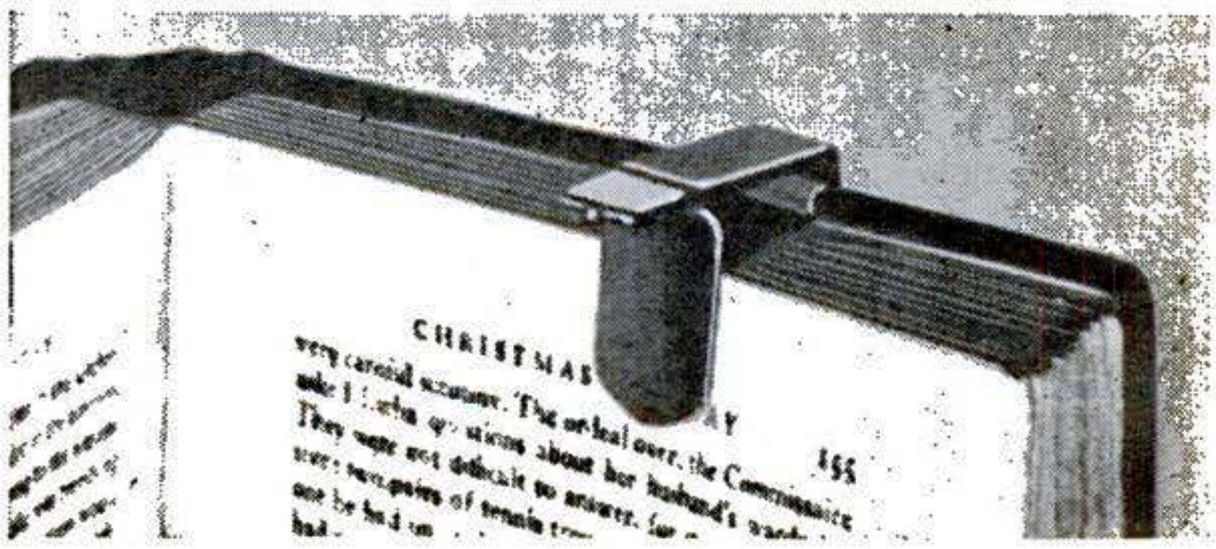
USING CATCHUP directly from the bottle usually is sloppy. This gadget, distributed by the W & E Sales Co., Inc., of Los Angeles, is intended to make catchup dispensing easier and give better control of the amount obtained. It consists of a pump that operates when a spring-returned plunger in the cap is depressed.





THIS RAZOR was designed to overcome some of the inconveniences of the ordinary safety type. It consists of a hollow, four-bladed shaving head and a detachable handle, both of which fit into a compact case. When the factory-attached blades are dull, the shaving head is discarded and an inexpensive replacement purchased, the only permanent parts being the case and handle. Packed in the case, the razor is easily carried in a pocket.

A BOOK MARK made by Sapphire Products, New York, automatically keeps your place as you progress through a book. A marking tongue flips up when you turn a page but quickly returns. A spring also draws the tongue toward the back of the book.



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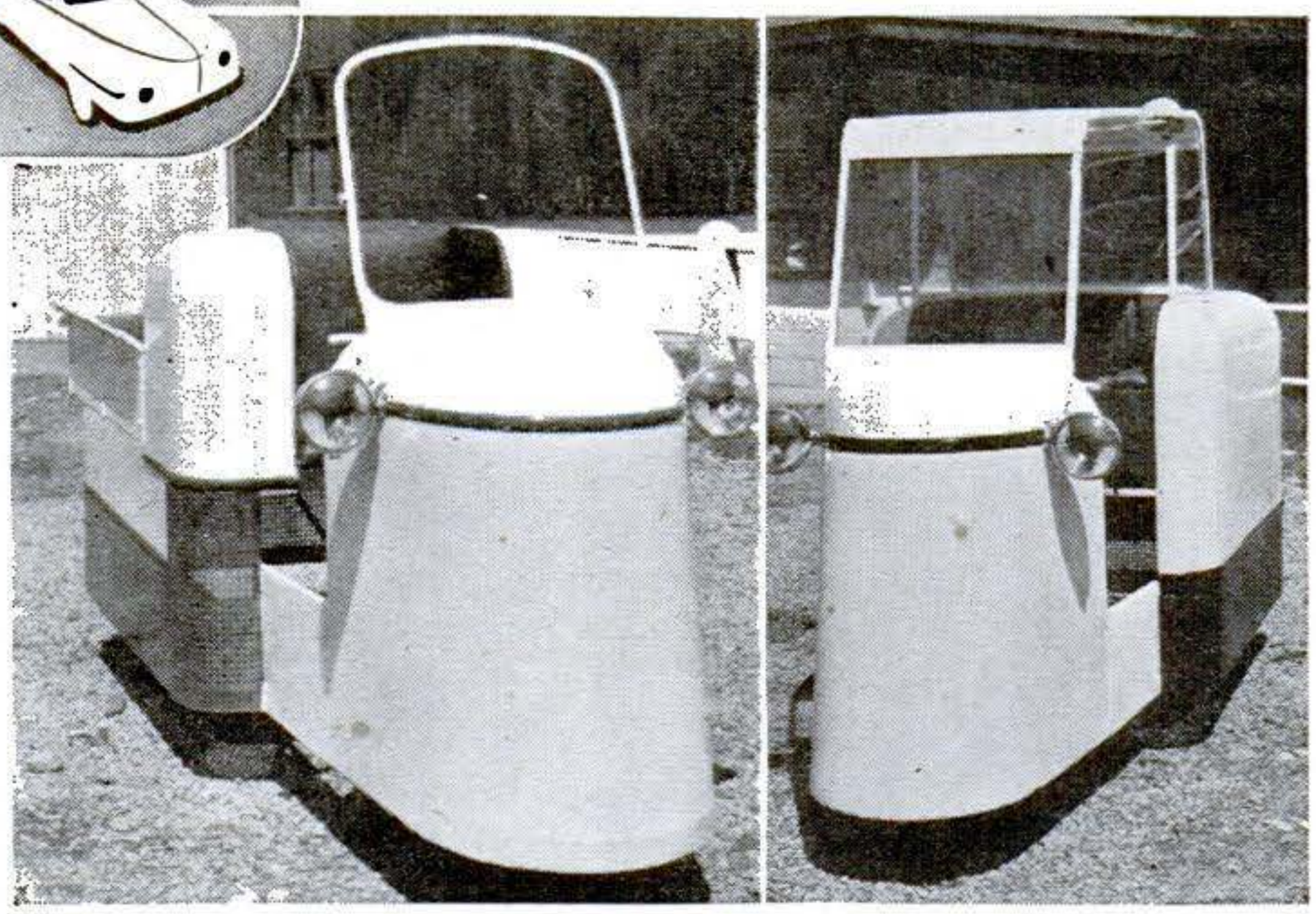
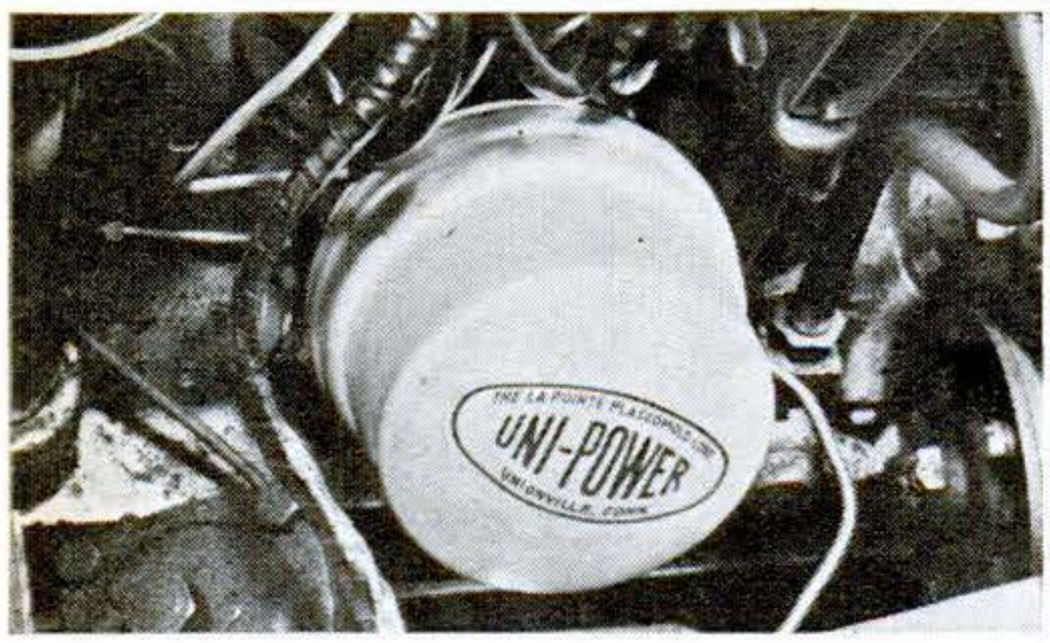
AUTO IDEAS

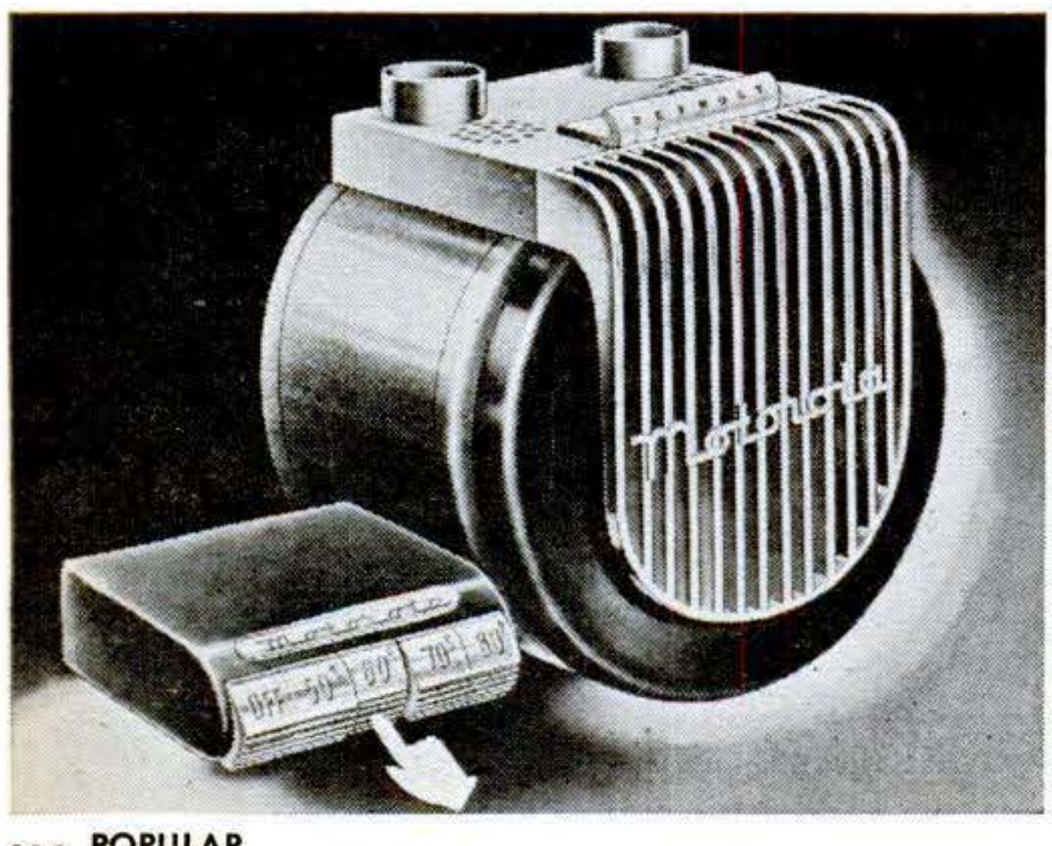


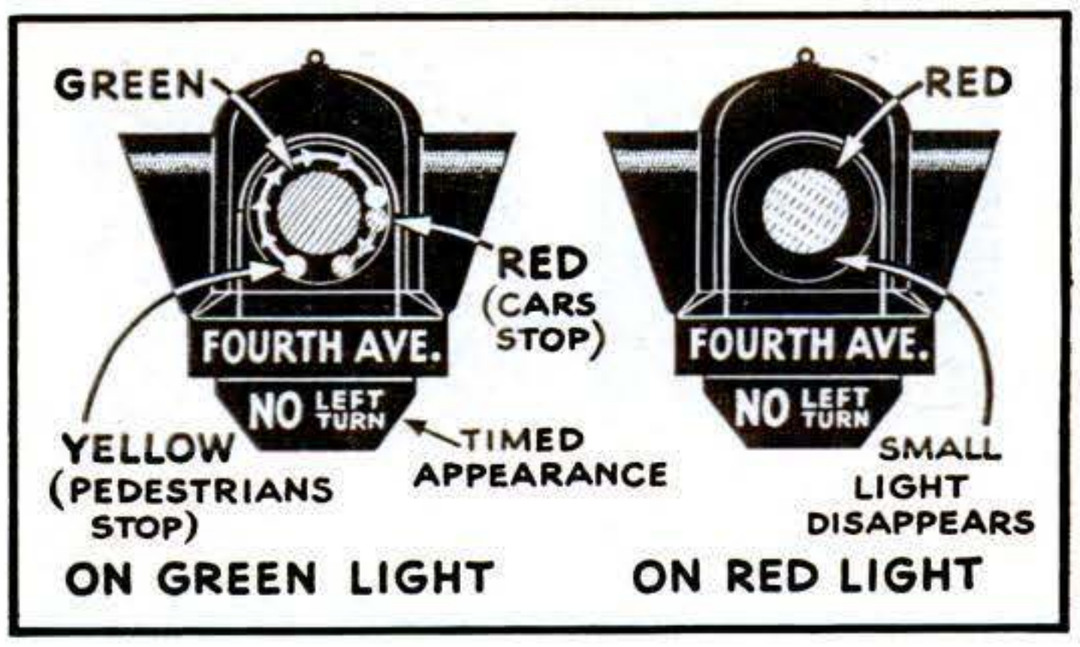
SMALL TRUCKS for small packages is the aim of the B and B Specialty Co. of Rossmoyne, O., which plans to make two new tricycle scooters, one a light pickup and the other a delivery vehicle, as soon as materials are available. Both models are powered by two-cylinder, 10-hp., air-cooled engines that give a top speed of 35 m.p.h. and 65 miles per gal. Capacity is 500 lb.



SINGLE-UNIT IGNITION SYSTEM. Combining coil, condenser, and distributor in one plastic-cased part, this new unit simplifies low- and high-tension wiring. The 2½-lb. "Uni-Power" has an aluminum cover to provide radio shielding as well as dust and moisture protection. Equipped with centrifugal spark advance and a neon light on the rotor arm, it can be used on aircraft or automobile engines, reports the La Pointe-Plascomold Corp., Unionville, Conn.

WITH THIS NEW CAR HEATER you just push the button to select the temperature desired. A thermostat then maintains that warmth, automatically adjusting the gasoline-burning "Motorola" heater. Cowl and under-seat models are made by the Galvin Manufacturing Corp. of Chicago.





A TRAFFIC SIGNAL that catches motorists trying to sneak through on the last seconds of yellow has been developed by a Detroit inventor, John J. Hammer. To prevent confusion from reflected sunlight, only one lens faces in each direction. The lens itself moves to change from red to green. The yellow warning signal is a small light that travels clockwise around the green disk and turns red just before completing its circle.

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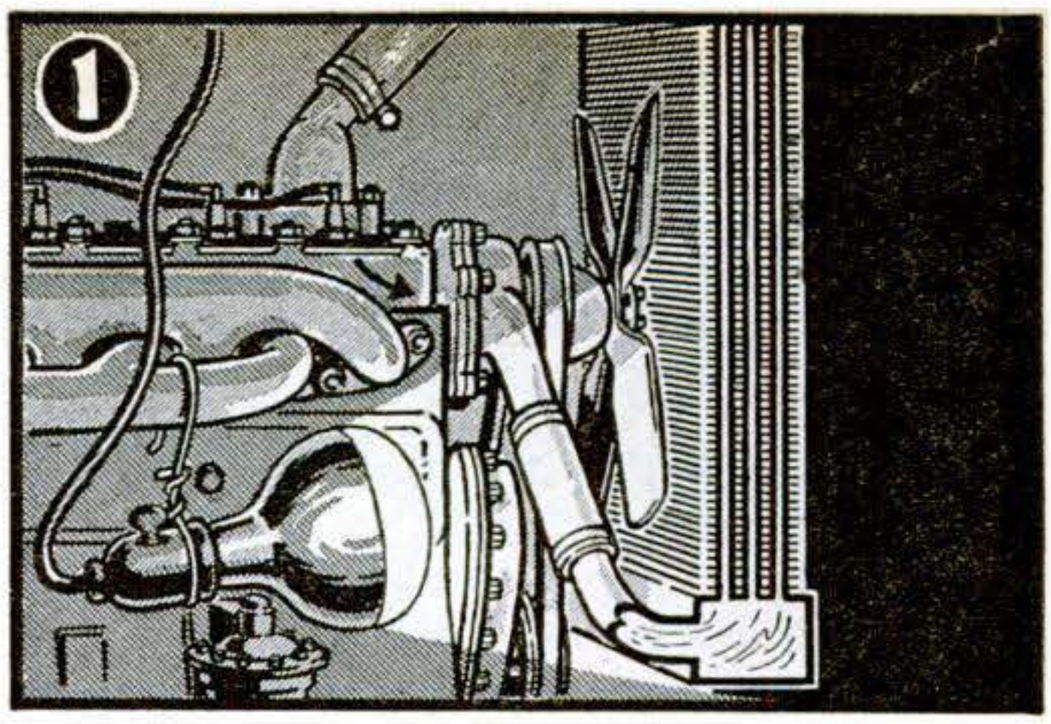
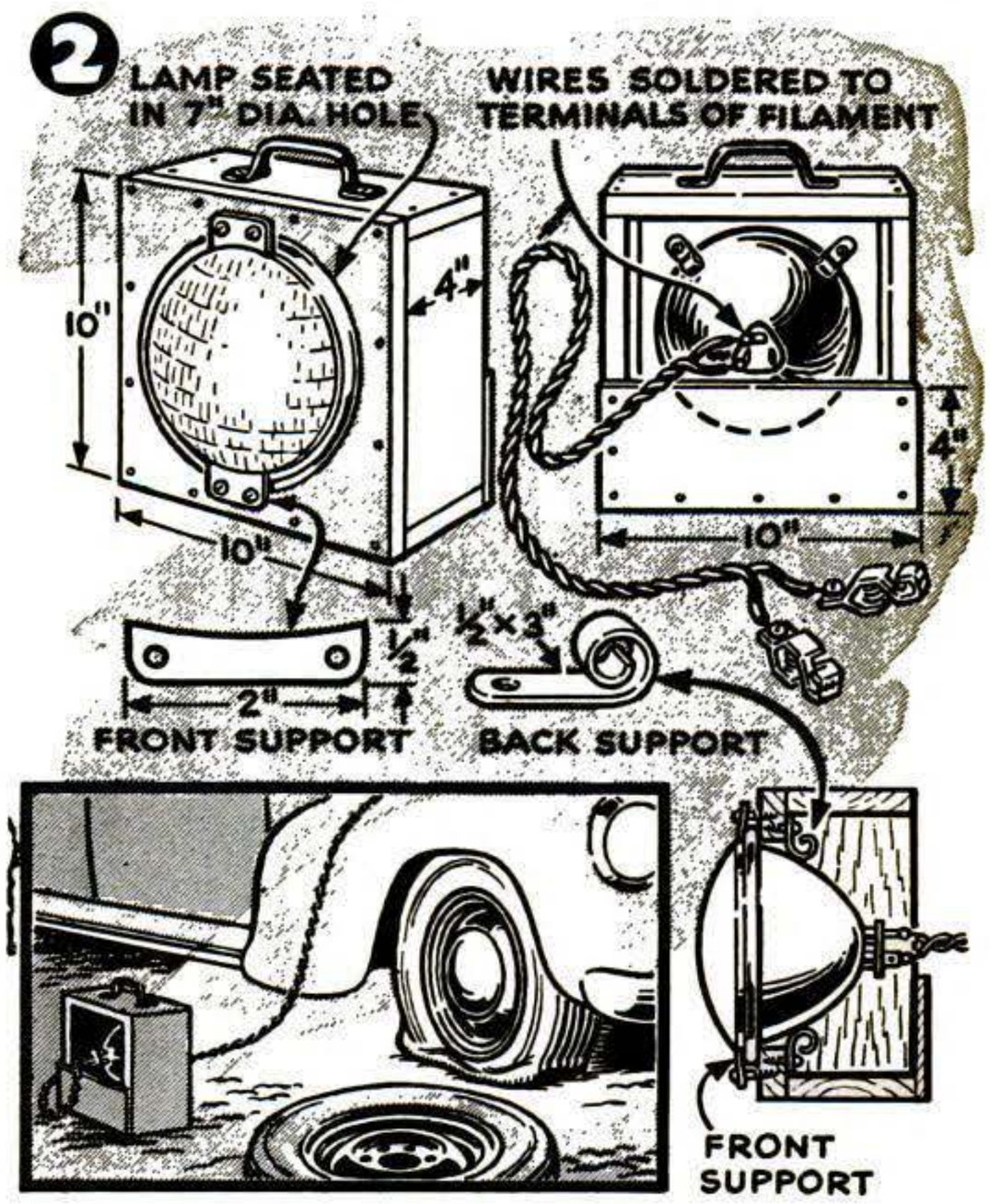
AUTO HINTS

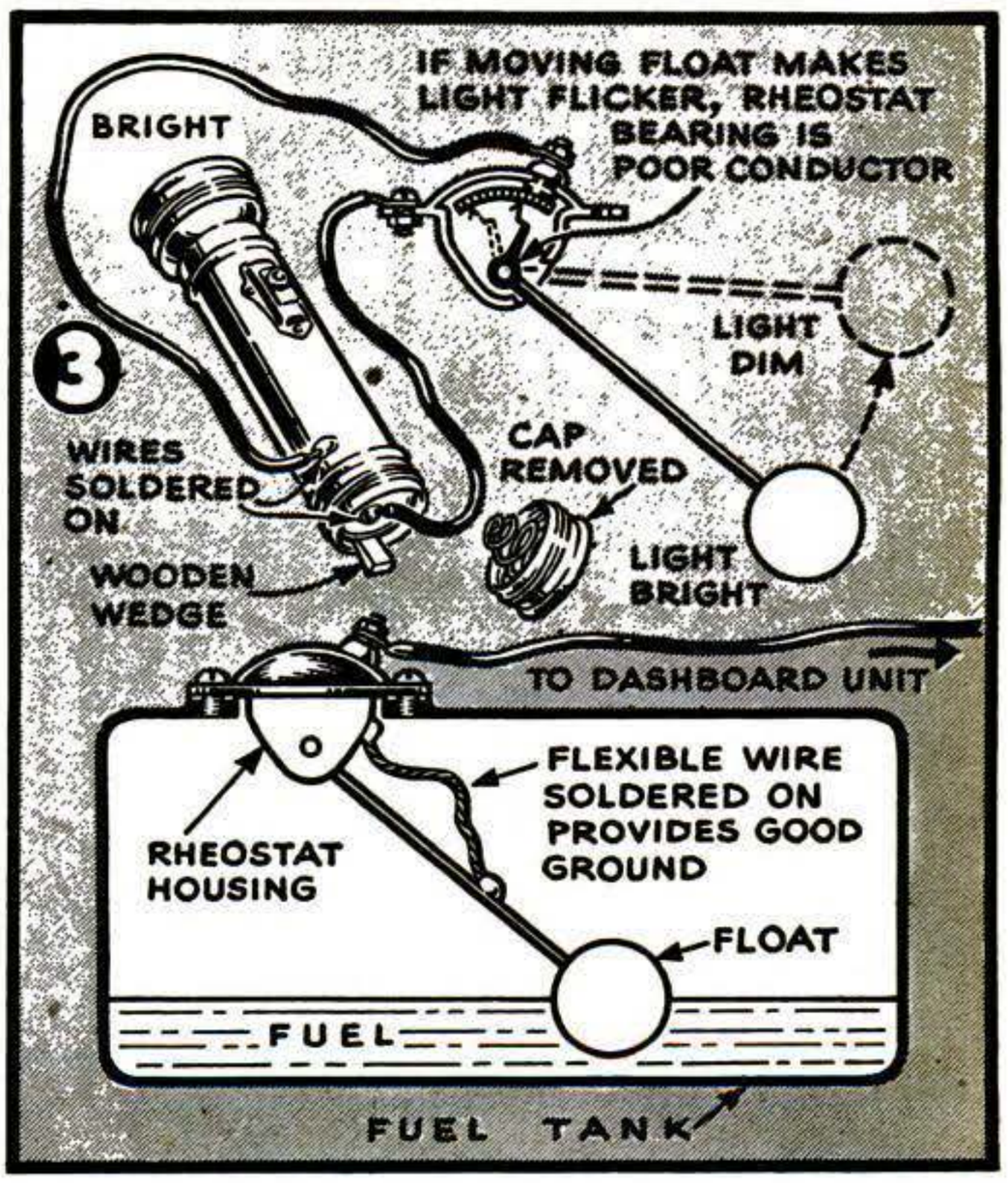
1. COLD-WEATHER STARTING in an unheated garage is often made easier by heating the engine independently. One way is to mount an infrared heat lamp under the hood and direct it on the bottom of the radiator. It will warm the engine in a short while. In very severe weather, it can be left on all night.—HARRY MORRIS.



2. A TROUBLE LIGHT can be made of a discarded sealed-beam lamp if a test shows one filament still to be good. Mount the lamp in a box and solder on two long wires ending in clips.—A. G. BELESON.

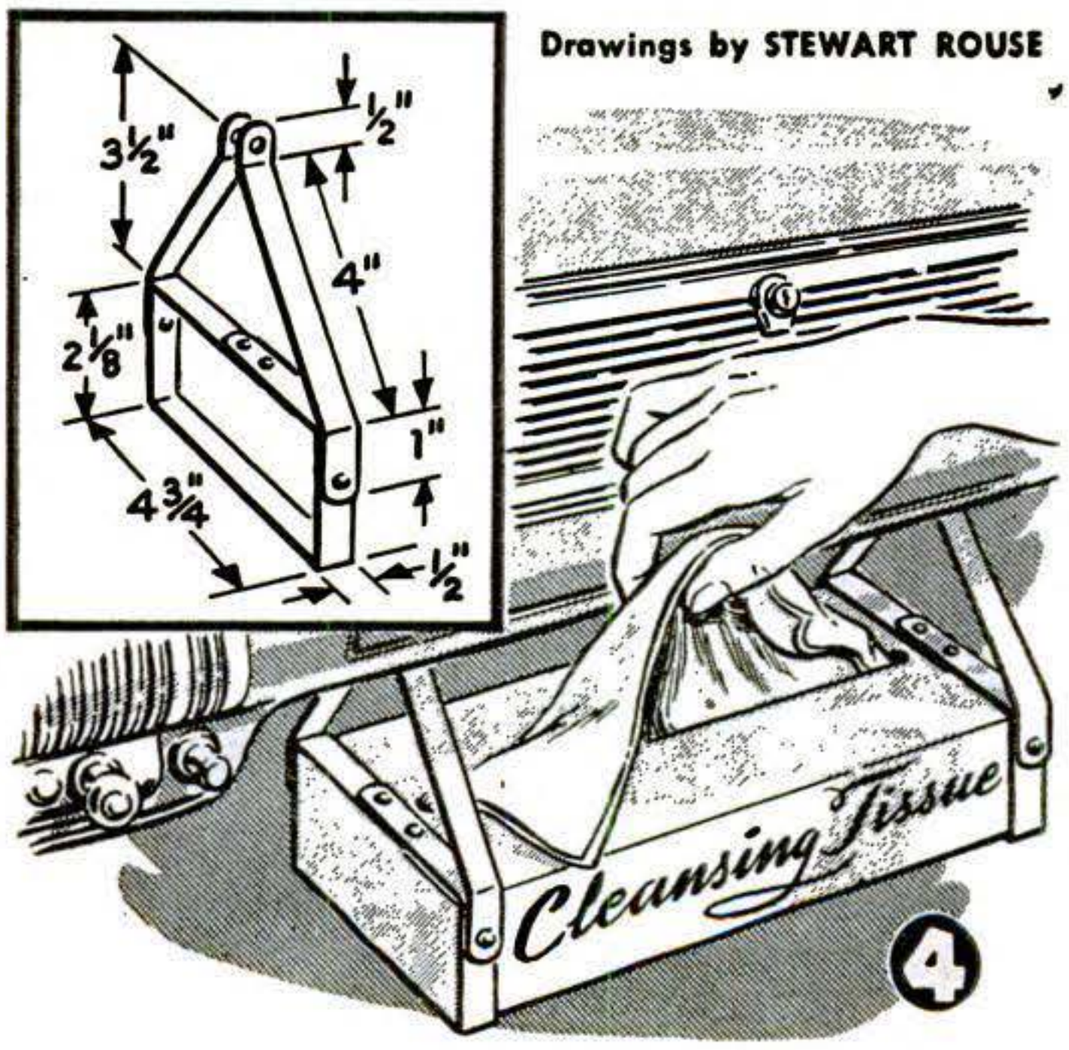


3. ELECTRIC FUEL GAUGES, which sometimes give trouble when the tank float arm makes an imperfect ground, can be repaired by soldering a jumper on the arm and rheostat housing. To test the old ground, remove the unit and connect it in series with a flashlight.—VAN ALLEN LYMAN.



4. CLEANSING TISSUES for use on a windshield, lenses, or soiled hands are conveniently held in banding-iron brackets under the dashboard. An empty box can be removed and a new one put in by spreading the bracket arms.—S. P. MEEK.

Drawings by STEWART ROUSE



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How to Get the Most Out of SYNTHETIC TUBES

By Walter E. Burton

THAT much of the nation's motor traffic rolls on air in synthetic-rubber tubes is proof enough that these tubes are practical. But to many a motorist they are as much a mystery as the A-bomb. He isn't quite sure how to mount these new inner tubes, is a little doubtful on the care they require, and often is at a complete loss when he has to repair a puncture or other leak. Some facts, straight out of the laboratories and factories where synthetic tubes were developed, may create a closer acquaintance.

There are four main kinds of inner tubes in use—natural rubber, GR-S, butyl, and neoprene. Many natural-rubber tubes date from prewar make. GR-S tubes are going out of the picture. Butyl tubes are the most widely made and may be the leading tubes of the future, no matter how plentiful natural rubber becomes. Neoprene tubes are not yet made in large quantities.

The initials GR-S stand for Government Rubber—Styrene. During the war this synthetic was made in Government plants by the copolymerizing of butadiene and styrene and was widely used for tires. Contrary to some belief, it is not highly resistant to oil. GR-S tubes are marked with a red stripe on the rim area.

Butyl rubber made in Government plants was known as GR-I. It is a synthetic formed by copolymerizing isobutylene with small quantities of isoprene or butadiene. Butyl tubes are marked with a blue stripe.

Neoprene produced in Government plants was known as GR-M. It is made by polymerizing chloroprene (monochlorobutadiene) and has good oil resistance. The identification stripe is yellow.

This is about how the picture shapes up now: Passenger tubes of all sizes and truck tubes up to 8.25″ cross section are to be made from butyl; larger tubes and special-purpose passenger tubes, such as Life Guards, Puncture Seals, and Life Protectors, of natural-rubber compounds.

Why tire and tube technicians believe butyl tubes are here to stay is revealed by a comparison of the properties of GR-S, butyl, and natural rubber. These comparisons, and other data given here, are based on information compiled by inner-tube tech-

Vegetable-oil soap is brushed on the exposed area of the inserted tube and for 2″ down in the tire.

Mount the tire on the rim, inflate to recommended pressure to seat the beads, deflate, and reinflate.

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Make sure there is no grit on the tube or inside the casing. Insert the tube, inflate until it is nearly rounded out, and replace the valve cap.
Photos by Firestone

nicians of The Firestone Tire & Rubber Co., B. F. Goodrich Co., and Goodyear Tire & Rubber Co.

In tensile strength butyl is but slightly inferior to natural rubber, while GR-S is only half as strong. Butyl can be stretched 14 percent farther than natural rubber, GR-S 10 to 15 percent less. Resistance to tear by butyl is essentially equal to that by natural rubber, while GR-S has but 55 to 60 percent of the resistance. Air diffusion or loss through GR-S is half as rapid as through natural rubber; through butyl it is only 5 to 10 percent as rapid.

You may have heard that, because butyls hold their air so well, they need not be inflated with the regularity or frequency of natural-rubber tubes. Tire technicians warn, however, that pressure should continue to be checked every week or so because of the possibility of leaks for other reasons. Synthetic tubes are more likely to be damaged by pinching and other underinflation evils than natural rubber, and it is even more important that leaks be discovered and repaired as early as possible.

One secret of getting maximum service from synthetic tubes regardless of type is proper mounting in the casing so they won't be stretched too thin at the rim and tire bead. Proper lubrication with a vegetable-soap solution and an inflation-deflation routine are the methods recommended by the Rubber Manufacturers Association, Inc., and tube manufacturers. Follow their suggestions yourself, and if a serviceman does the job watch to see, for instance, that he doesn't skip deflation and reinflation.

Here are the six steps recommended:

1. Remove the valve core and use the valve cap to hold air in the tube. After making sure that the inside of the casing and the outside of the tube are free of grit and other foreign material, insert the tube in the casing. Inflate until the tube is nearly rounded out and replace the valve cap.

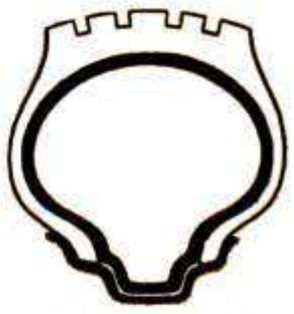
2. Dissolve enough neutral vegetable-oil soap to make a decidedly "soapy" liquid and apply it with a brush or cloth to the visible portion of the tube and for about 2″ down the sides of the tube inside the casing. Soap also the inside of the casing for the same distance and soap both surfaces of the flap used with flat-base rims. Do not use so

FLAT-BASE RIM | **DROP-CENTER RIM**

Brush vegetable-oil soap on areas shown in color.

Soap down about 2″ between tube and casing.

Inflate to full pressure, deflate, and reinflate.



The beads snap in place at the first inflation.

Soap and two inflations avoid uneven stretching.

Thinly stretched parts will wear prematurely.

From Rubber Mfg. Assn., Inc.

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WAFFLE-RIBBED surfacing is put on the new synthetic butyl inner tubes of the United States Rubber Company. The extra butyl is said to crowd around a puncturing nail and thus to reduce the rate of air escape. This allows a car to be driven farther before stopping for a repair.

much soap that it runs down into the tire.

3. Center the tire on the rim, keeping the beads out of the rim well of a drop-center rim. Inflate to partial pressure, supporting the tire with the hand so it will not hang loosely on the wheel.

4. Manipulate the valve stem until it is centered in the hole. Pull it firmly against the rim and hold it there while the tire is being inflated to recommended pressure.

5. Deflate the tire completely by simply removing the air hose. Then replace the valve core in the stem.

6. Reinflate to recommended pressure. You need not worry about centering the casing on the rim. The first inflation forces the beads to seat themselves. But during this step the tube is often stretched unevenly, and a second inflation is necessary to give it a chance to adjust itself.

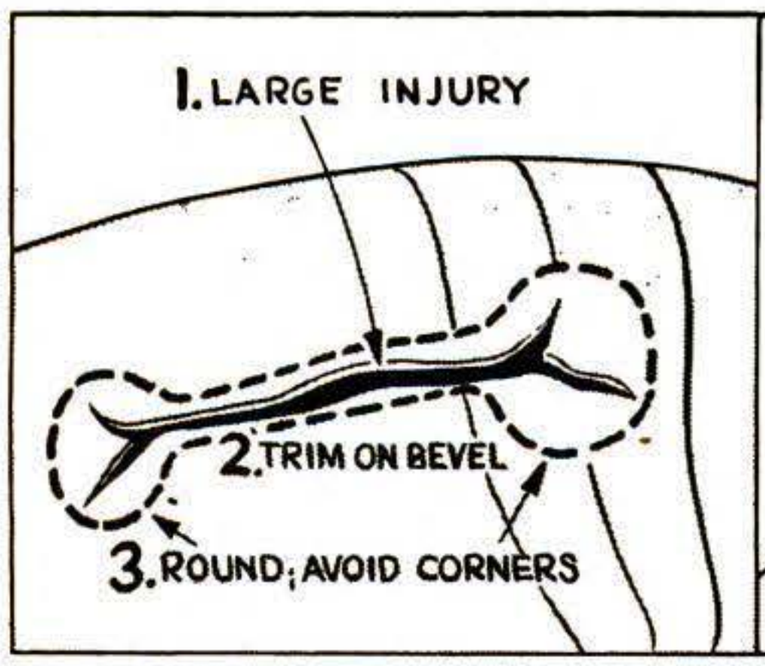
Warning: When the core has been removed from the valve, inflation with a high-pressure air line that has no pressure-regulating device may prove dangerous. The sudden entrance of air at high pressure may snap the beads against the rim with such force that they will be damaged and later on may cause a blowout. Sudden inflation has also been known to cause a tire to explode. Though removal of valve cores is common practice, it may be better for the novice to leave them in as a safeguard to restrict the valve opening if he uses an air hose having no pressure control.

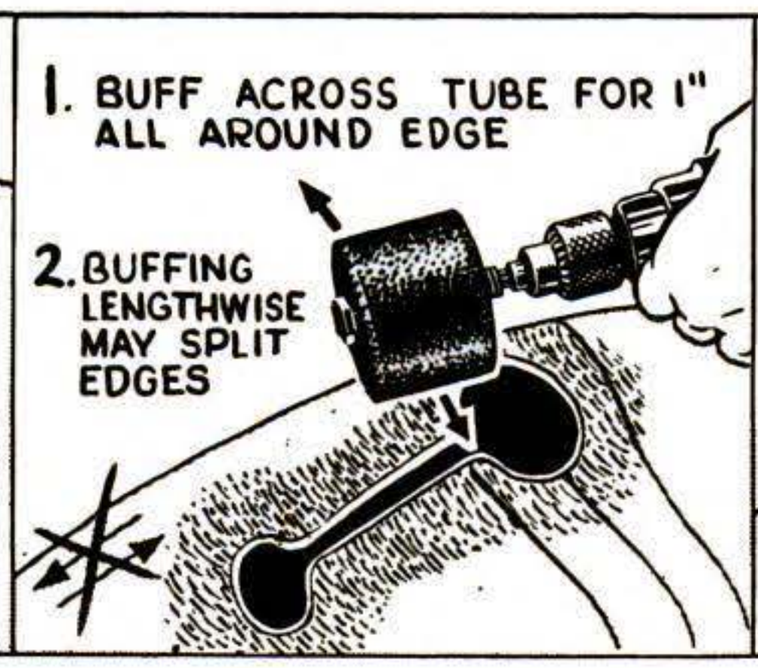
When a synthetic tube is inflated out of the casing, as in testing for a leak, be careful not to admit so much air that the tube will be stretched beyond its original size. Once so stretched, a synthetic tube hardly ever comes back to size.

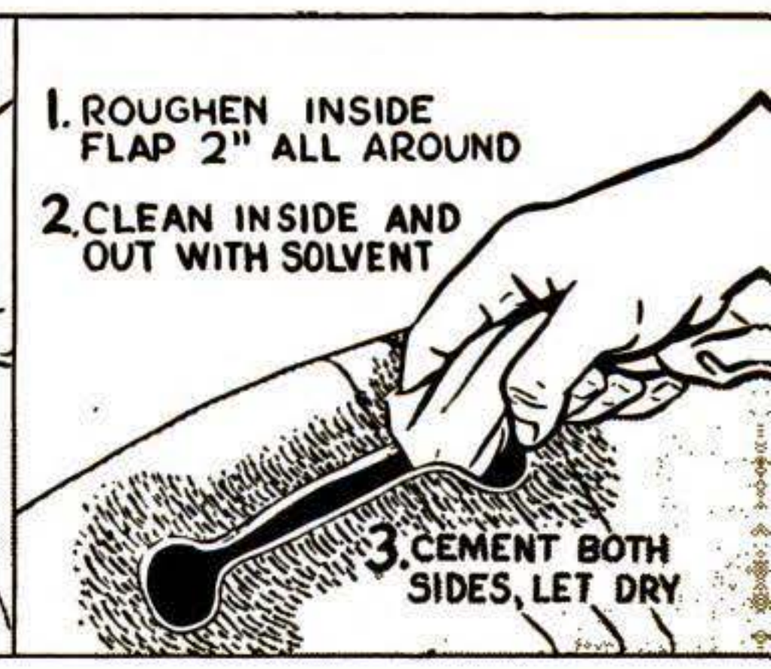
The care given a natural-rubber tube is also required for one of synthetic rubber. That is, inflate to recommended pressure, always use a cap on the valve, and check pressure regularly.

Patches are made on synthetic tubes in the same manner they are on natural-rubber tubes, except that for injuries 1″ or more long GR-S tubes require a reinforcement patch on the inside. Both hot and cold patches can be applied successfully. Tire manufacturers recommend heat-vulcanized patches for permanency. Motorists who still have on hand hot or cold patches made of prewar rubber should not use them on synthetic tubes, but save them for repairs on tubes of natural rubber.

For GR-S as well as butyl tubes having punctures or holes less than ½″ long, trim the







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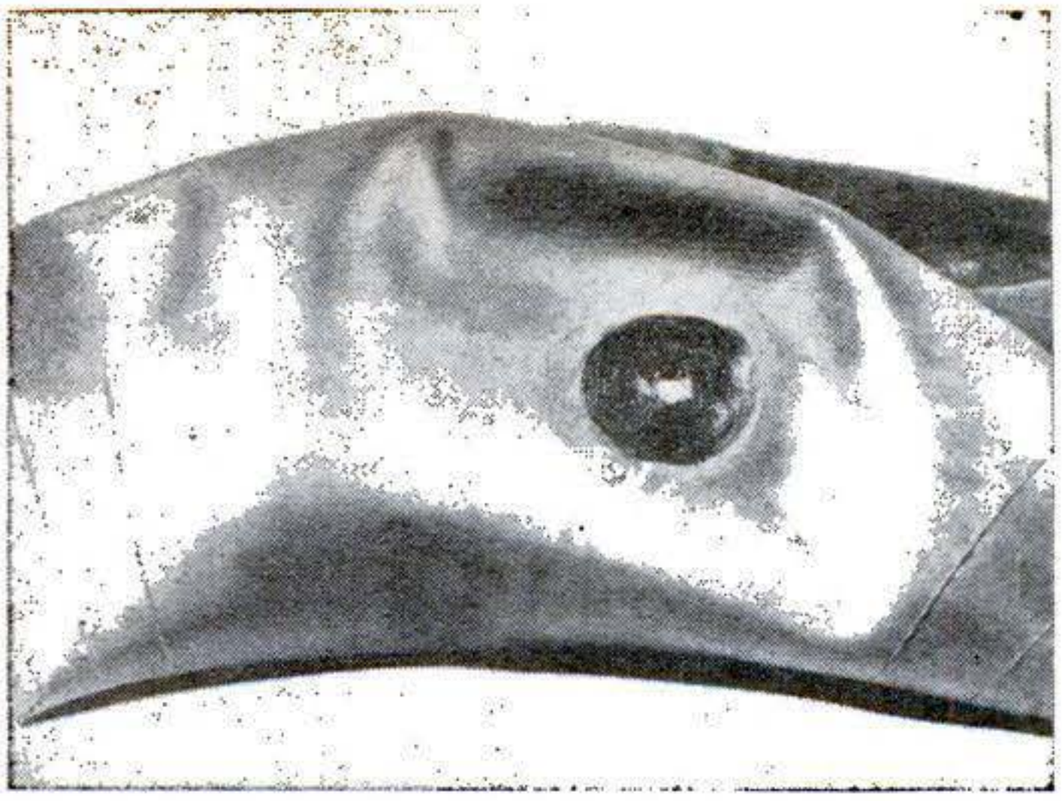
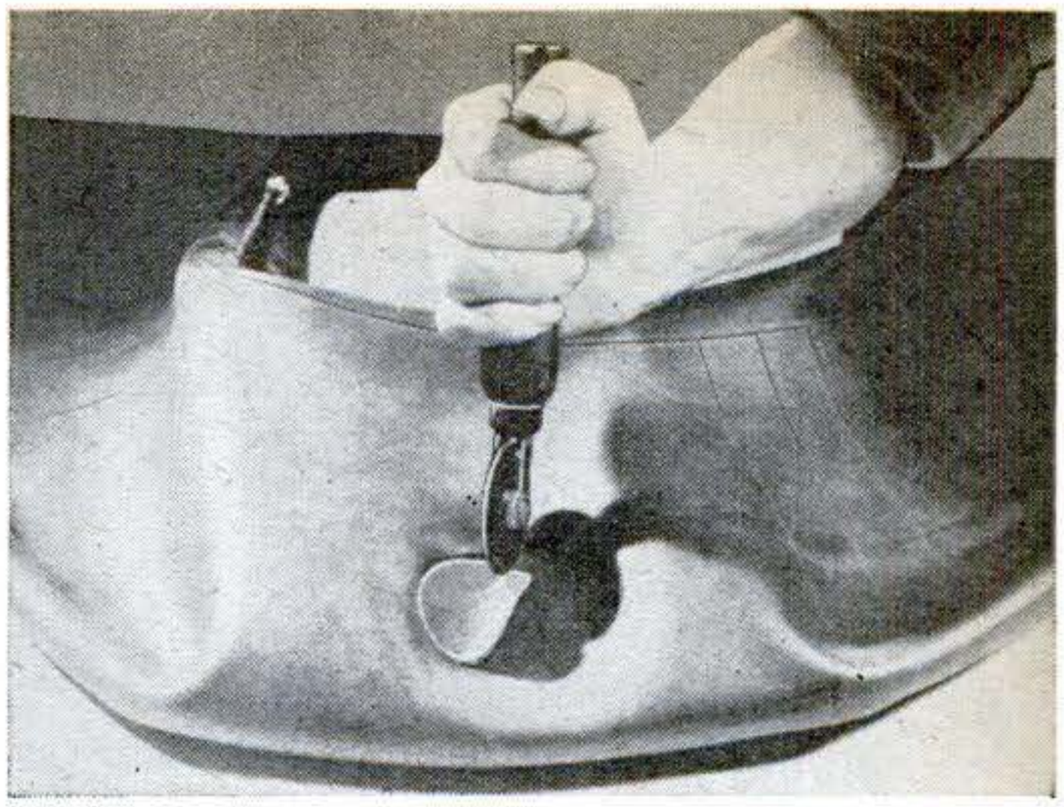


After a small hole is trimmed, an area is buffed ½" larger than the patch, and cement is applied.



Photos by Goodrich

When the cement has dried, a beveled-edge patch is centered over the hole and rolled down hard.

edges to remove sharp corners where a tear might start and roughen an area about ½" larger around than the patch will be. Always buff at right angles to the grain of the tube, which runs parallel to the large circumference, to avoid the possibility of starting a split. Remove the surface glaze, but do not cut or scratch the tube deeply.

Clean the roughened area with solvent or cold-patch rubber cement worked in with a knife blade. Wipe or scrape off excess cement. Spread more cement over the area and let it dry.

For nail holes and the like a prepared round patch with a beveled edge can be used. For other holes cut a patch to extend 1" beyond the edge in all directions, and bevel the outer edge of the patch at about a 45-deg. angle. Center the patch over the hole and roll it into good contact with a roller, fruit jar, tin can, or the edge of the repair kit.

A method of applying an inside as well as an outside patch to a large injury in a GR-S tube is shown in the drawings below. Note the dumbell appearance of the trimmed hole to avoid sharp corners at the ends.

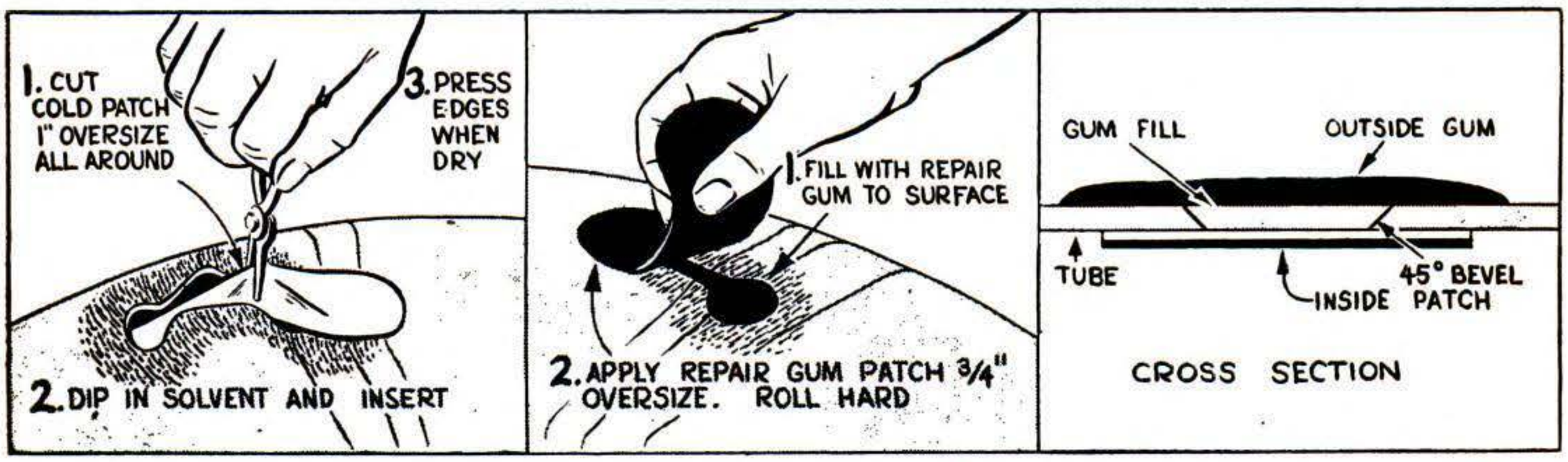
The inside of the tube is roughened as well as the outside, washed clean with solvent, and coated with vulcanizing cement. A cold patch 1" larger than the injury in all directions is dipped in solvent, inserted, and pressed down on all edges when dry.

Next, the injury is filled with quick-cure repair gum, and a sheet of quick-cure gum is applied on top and rolled down firmly. This final patch should be ¾" larger than the hole in all directions. As the final step, the repair is **vulcanized.**

The same method may be followed for holes larger than ½" on butyl tubes and for those between ½" and 1" on GR-S tubes, omitting the inside patch and gum fill.

Though it may be preferred to take vulcanization jobs to a service station, a motorist can get satisfactory results with a vulcanized-patch kit. He should specify in purchasing it whether the patches are to be used for synthetic or natural-rubber tubes. When the largest patch won't cover the injury, two or more may be applied in succession. After the first is placed, roughen part of its outer surface, and apply the second patch to overlap it ½" or more.

Drawings adapted from Goodrich and Firestone



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MEL MOWBRAY runs a farm quite a distance from our town, but he stops at the Model Garage to fill up with gas whenever he is down our way. In the course of the past 10 years he and Gus have built up a strong friendship.

One winter morning Gus looked up from a job in the shop and saw Mel's car through the window, so he strolled out to the gas pump for a chat. Stan Hicks, the Model Garage grease monkey, had been checking Mel's oil and was holding out the bayonet gauge for the big farmer's inspection.

"All right, put in a quart," Mel told him sourly and turned to Gus. "My car is using a lot of oil," he complained, "a quart every 200 miles."

"How long has that been going on?" Gus asked.

"Oh, just the last couple of weeks," Mel replied absently.

"It's probably your winter oil," Gus said reassuringly. "This unusual warm weather thins it out quickly. If you don't notice an improvement when it turns colder, you'd better have a check."

Then he changed the subject as Mel nodded because Mel has always had repairs done at the country garage in his neighborhood and Gus didn't want to cut in.

"Get that washing machine for Mrs. Mowbray yet?" he asked.

Mel shook his head, a disappointed look on his ruddy face. "That's what I came to town about," he said. "We've been promised the machine for the past six months, and now the dealer says we'll have to wait another month at least."

He paid Stan for his gas and oil and got into his car. "Stop by and visit us when you're out our way," he told Gus cordially. "Mary says to tell you she hasn't forgotten how to bake pie."

Gus's grin was full of fond recollection. "I'll be dropping in one of these days, all right," he promised. "Tell Mrs. Mowbray her pie is worth a trip twice as far."

That day arrived some three weeks later. The unseasonable weather had changed, and to balance his books Old Man Winter had sent along a heavy snowfall and followed through with a seemingly endless succession of days on which the mercury never climbed as high as the freezing mark.

"Better take the word of a man who knows," Elmer snapped. "If you wait too long and ruin your car, don't blame me. She's pumping oil, I tell you."

Gus had been on a business trip and was driving home when he reached the crossroads near Mel's little farm late on a bitter afternoon. The red sun had sunk below the hills to the west, leaving behind a gray-green sky against which the bleak pines on the snow-clad ridge stood out black and hard. A little tired and a lot hungry, Gus pictured himself in Mel's old-fashioned kitchen, a wood fire blazing in the big range, and stout, rosy-cheeked Mary Mowbray plucking a steaming pie from the oven. He turned from the clean-swept concrete highway to the snow-rutted country road.

After 20 minutes he came to a poplar-bordered lane leading from the road a couple of hundred yards to Mel's farmhouse.

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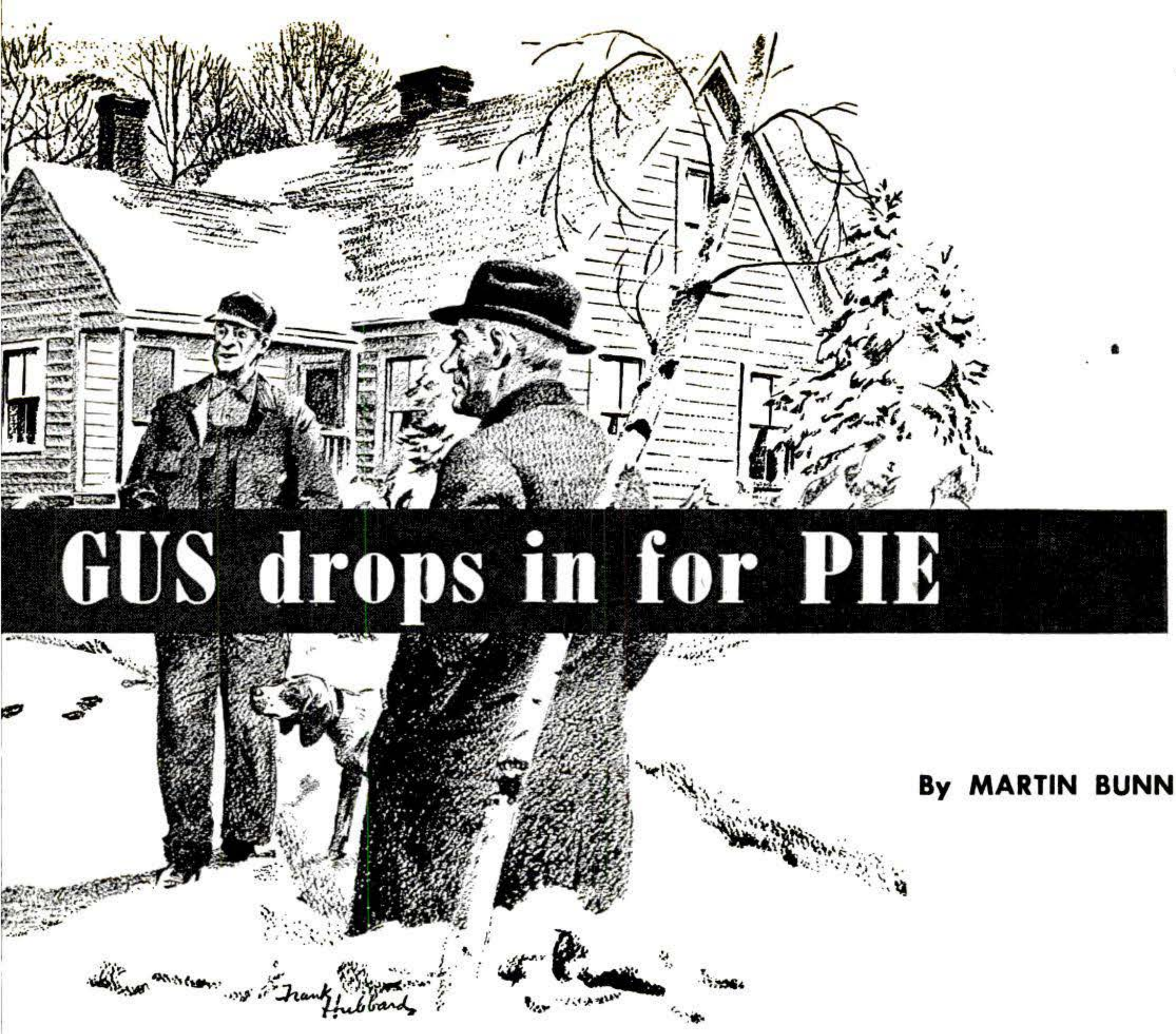


GUS drops in for PIE

By MARTIN BUNN

Gus looked up the single set of ruts and saw a strange car at the house.

"Guess I'd better get out and walk," he said half to himself. "There's no way to get past that fellow, and I don't want to back the whole way down here."

A biting wind smacked him in the face as he got out of his car. He bowed his head and started trudging. Pretty soon his eyes caught a small dark spot on the ice-glazed snow halfway between the deep ruts. Then 100 feet farther on he saw another, and then another, another, and another, all about the same distance apart.

Gus was near the house when Mel came out with a sharp-featured young man who was wearing a sporty overcoat over coveralls.

"Hello, Gus!" Mel boomed. "You're a sight for sore eyes. Come on in and have supper. But where's your car?"

"Down at the far end of your one-way street," Gus grinned. "I didn't think there was room for two of us to pass."

The young man looked inquisitively from Gus to Mel, but the farmer, though his face grew a shade redder than years of sun and wind had turned it, made no move to introduce his visitors.

"Thanks for bringing the battery over, Elmer," Mel said. "I'll have to think about that other job."

"Better take the word of a man who knows," Elmer snapped. "If you wait too long and ruin your car, don't blame me. She's pumping oil, I tell you. That war gas and oil filled your piston-ring grooves with gum, and the rings can't move—the oil just blows past them."

"But $90 is a lot of money," Mel demurred.

"Sure it's a lot," Elmer agreed, "but it's easier to pay for tearing down your engine, cleaning out the grooves, and installing new rings than it is to get a new car." He turned to Gus. "Am I right, mister?"

"Well," Gus hedged, "new cars are hard to get."

"You're right, they're hard to get," Elmer

Copyrighted material

snorted. "I'll take you down to the road, mister, if you want to drive your car in."

"Thanks," Gus said, and got in with him. "I'll be back in a minute, Mel."

"Peters is my name—I'm in the automotive line," Elmer announced importantly as he let in his clutch. "I do business up here in the sticks, but I do it in a big-shop way. My toughest job is selling these farmers *preventive* maintenance. Mowbray's car, for instance, is pumping oil—"

"Have you tested it?" Gus asked innocently.

"Test!" Elmer retorted scornfully. "I know what's wrong without wasting time on tests."

"That's a gift," Gus said mildly. "Well, thanks for the lift."

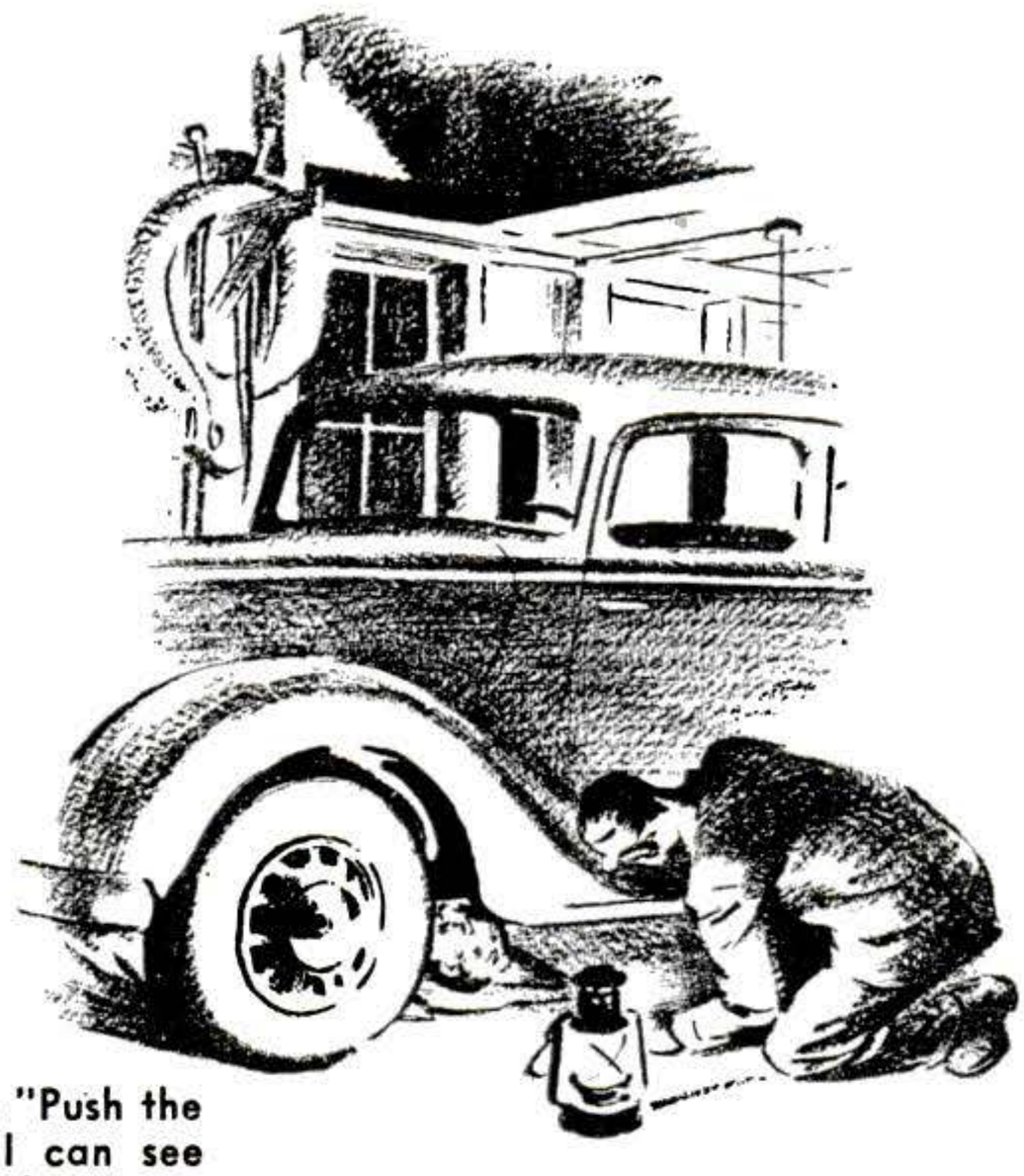
Elmer regarded him with suspicion. "Up here on business, mister?" he asked.

"No, just paying a social call," Gus replied, and got out.

He drove his own car slowly back to the house, his eyes on the snow between the ruts. Mel was waiting at the door, and Mrs. Mowbray welcomed him in the kitchen with: "Supper's on the table, Mr. Wilson. Make yourself at home and fall to."

Gus did that with a right good will. Mel was looking worried, but his wife chatted happily. Then after dessert—her famous deep-dish apple pie—she burst out with a piece of news.

"The dealer phoned today," she beamed. "He has the washing machine."



Gus crawled under the car. "Push the lantern a little closer so I can see the crankcase pan," he said.

Mel mumbled something and then, when Gus had finished his coffee, he led the way to the parlor. "I hate to disappoint Mary," he told Gus quietly. "But $90 to repair the car means no washing machine."

Gus lit his pipe. "Mel," he said, "I'm going to do something I've never done before—butt in on another shop's job. Can I take a look to see what's wrong with that car of yours?"

"Of course," Mel agreed eagerly.

They went into the barn, Mel with a lighted lantern. Gus had him race the engine while he watched the exhaust. There was no telltale blue smoke. Then Gus crawled under the car. "Push the lantern a little closer so I can see the crankcase pan," he said. The bottom of the pan was streaked with wet oil.

Gus backed out from under the car, got a socket wrench from his own tool box, and crawled back under. The first pan bolt he tried required a full turn to tighten, and some were so loose they took more than two full turns.

"Go ahead and buy Mrs. Mowbray her washing machine," Gus grinned as he got up, brushing his trousers. "You aren't going to have any more trouble. The oil-pan bolts are apt to loosen up and cause a leak on almost any car after it's been driven for a time—sometimes from vibration, sometimes gasket shrinkage."

"But how did you know what to look for?" Mel asked bewildered.

"I saw you had a leak when I was walking up your lane," Gus told him. "It was yours, all right, because there were no more spots after Elmer drove down—just one spot every hundred feet."

"Doesn't sound like much of a leak," Mel said doubtfully.

"No?" Gus went on. "Well, a drop every hundred feet is 50 drops a mile. You said you used up a quart every 200 miles. Let's see, 200 times 50. I don't know how many drops there are in a quart, but 10,000 drops make a lot of oil."

Mel grinned. "Gus," he said, "you're the best friend I've ever had. Make out your bill, and I'll pay you—even if it's $90."

"Bill?" Gus laughed. "I'm not on shop time now. Just call the job my thank-you gift to Mrs. Mowbray for the pie. And when she gets that washing machine, she'd better invite me back here for another slice."

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MECHANICS AND HANDICRAFT

- Two-Tube Hi-Fi Receiver
- Flexible-Shaft Tool
- Jewelry Molded of Dental Silver
- Animal Photos by Flash
- Chemistry of Emulsions

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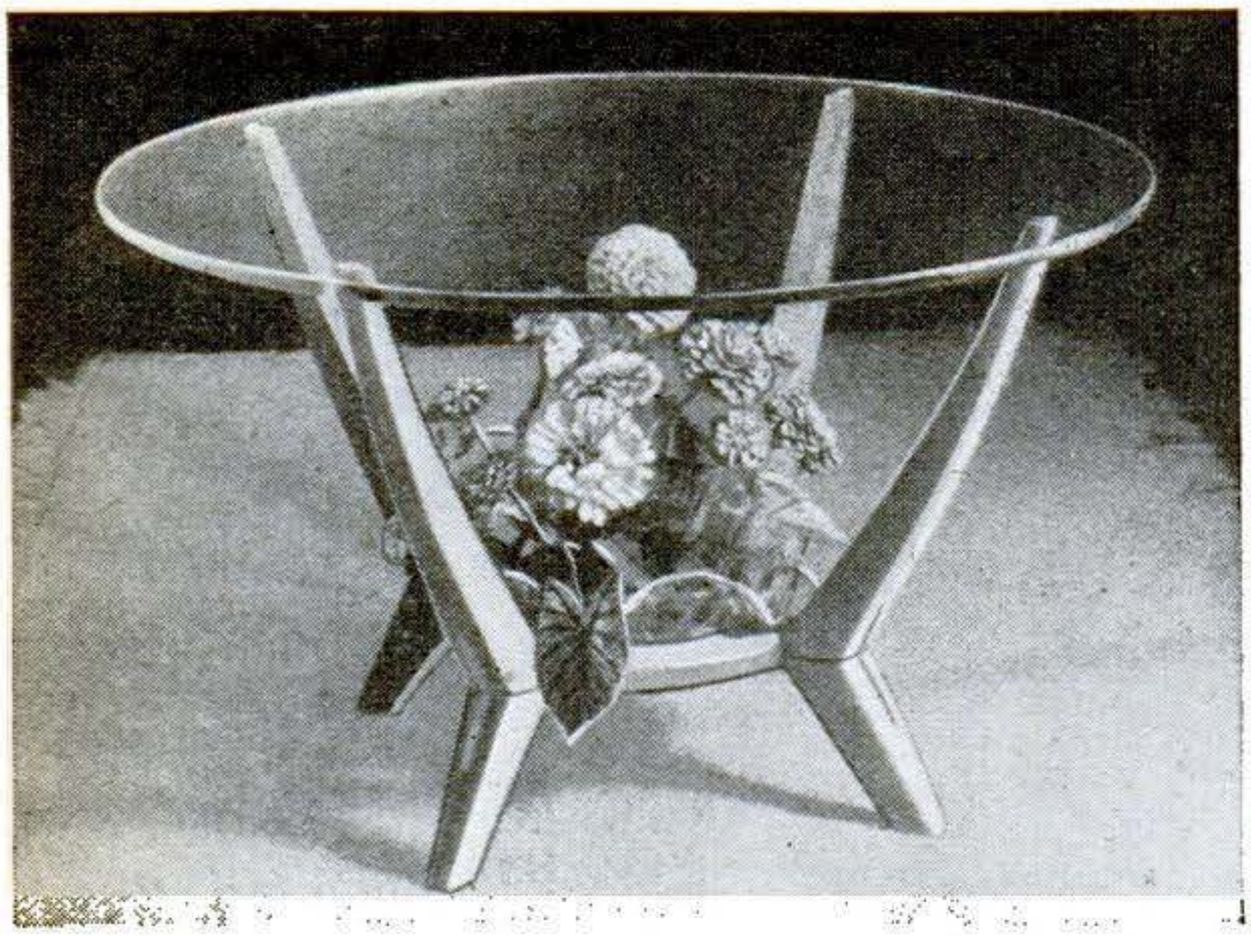
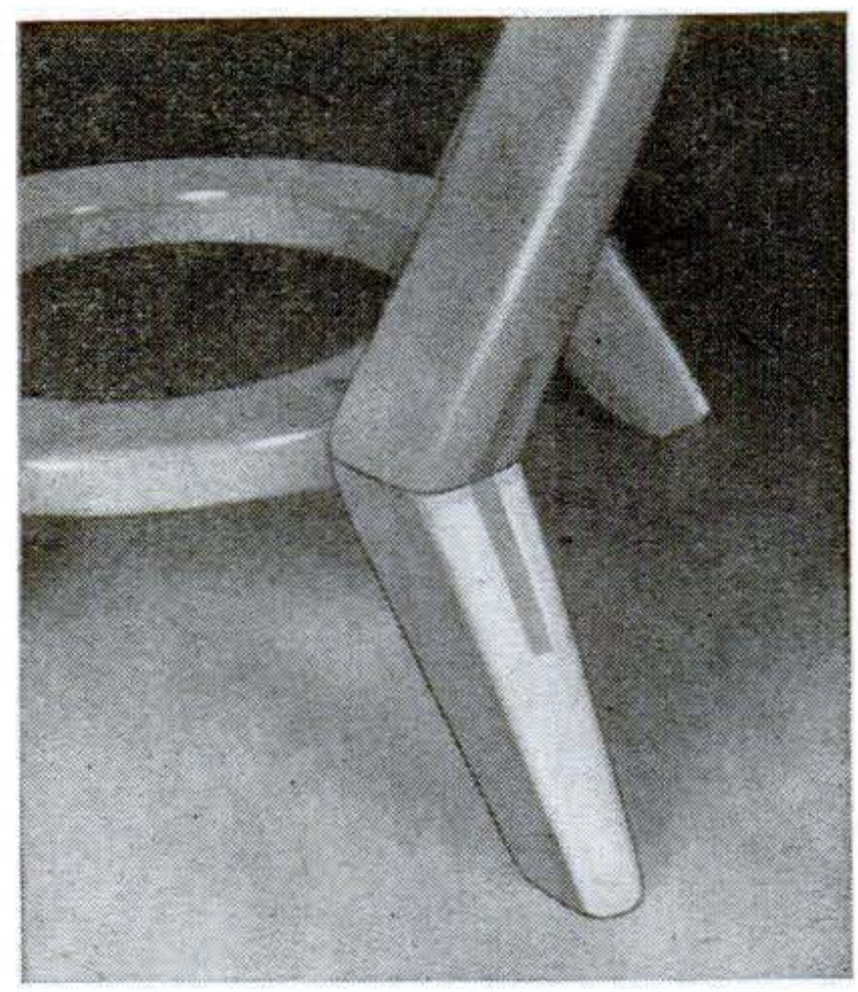
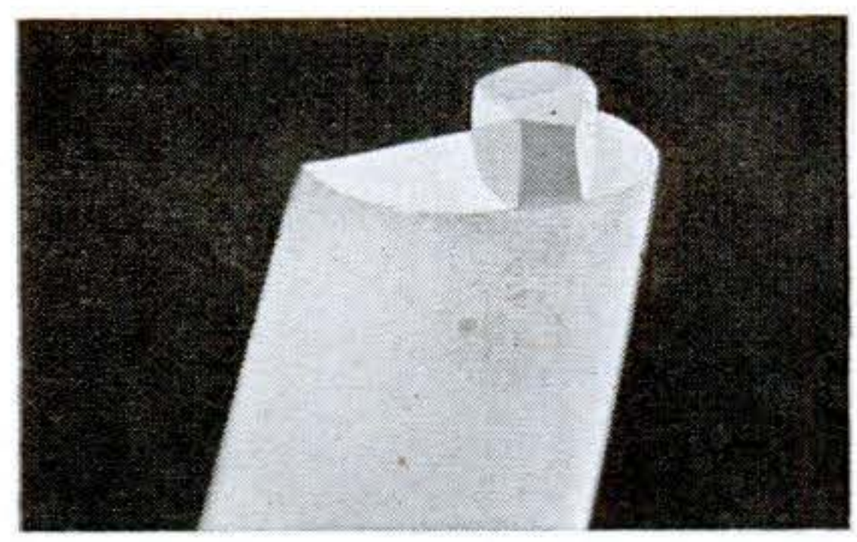


Coffee Table

IN THE MODERN TREND





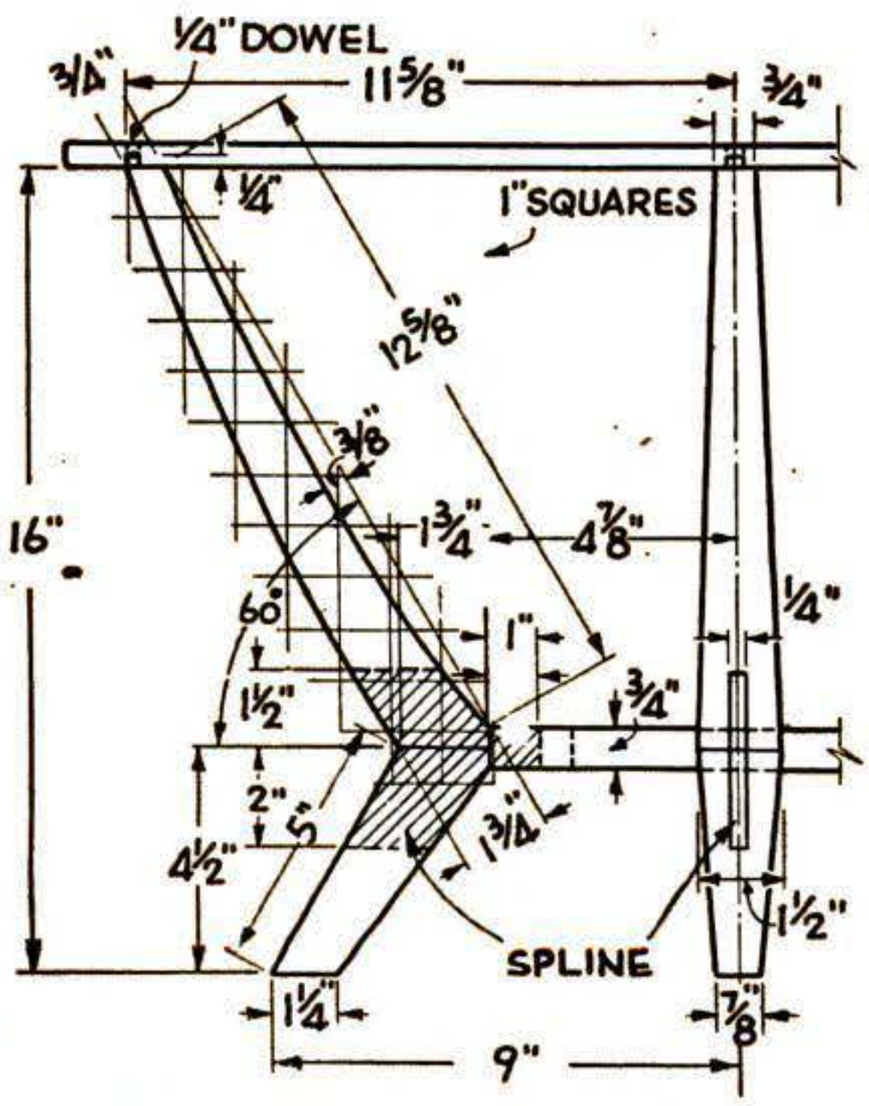
by **BERNARD I. BELL**

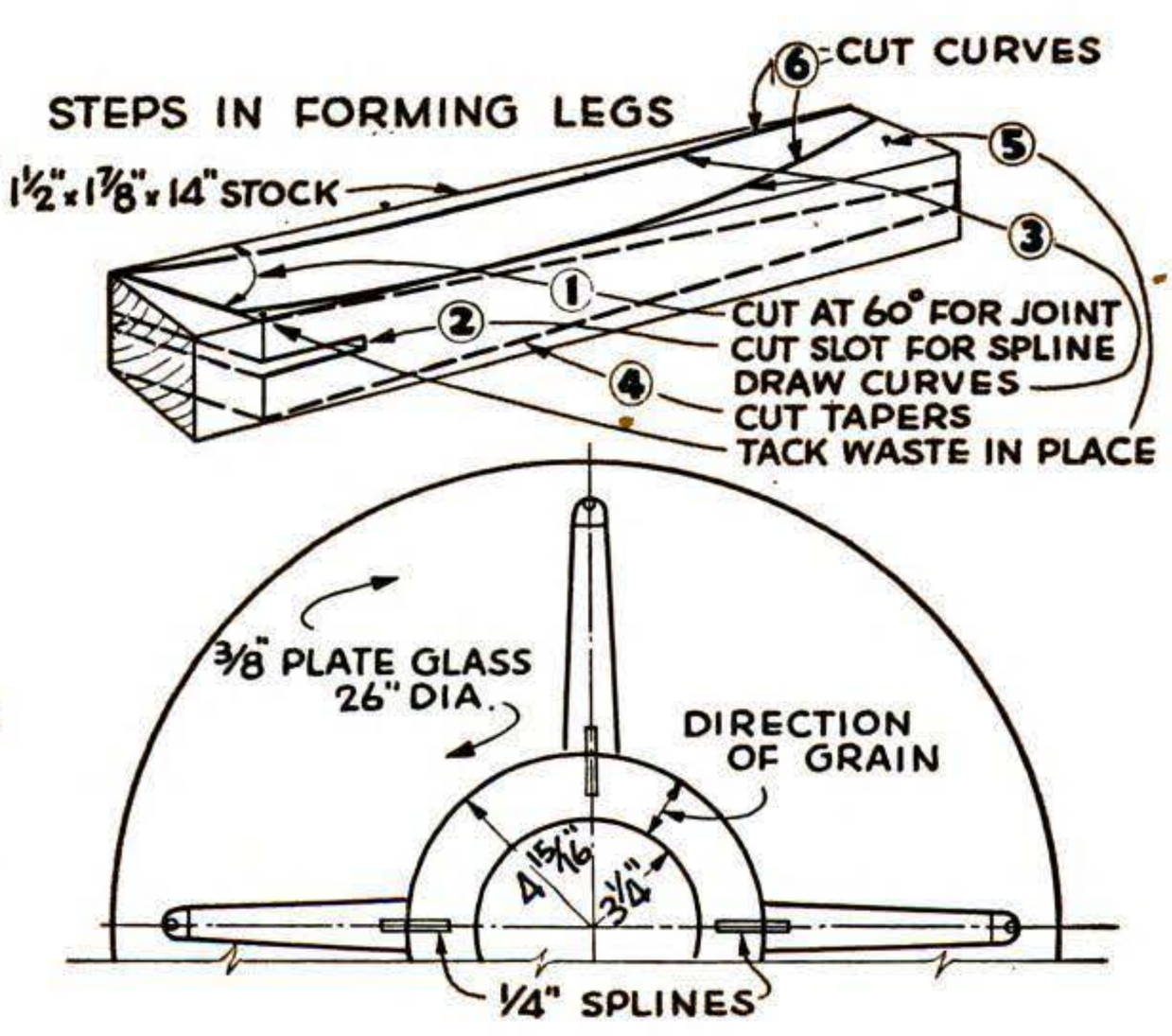
A GRACEFUL conversation piece, this flower-holding coffee table can be made from a few lengths of wood and one piece of plate glass. Its simple lines fit it to period as well as modern furnishings.

For the legs, 1½″ by ⅞″ stock is needed. The upper portions require 14″ lengths, and the feet 6″ lengths. The ring center is cut from a 10″ square of ¾″ solid wood or plywood.

The first step in construction of the legs is the preparation of a full-size profile pattern. Then the angled joints between the two pieces of each leg can be cut and checked against the pattern. The matching surfaces of these joints should be sanded perfectly smooth and flat to insure a tight glued bond. Afterwards cut the slots for the Y-shaped splines that lock together the two parts of the legs and the center ring.

The curved sides of the upper legs are laid out





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from the pattern. Saw the taper first, tack back the removed portions with fine wire brads driven into the sections outside the curves, and cut to the profile curve on a jigsaw or bandsaw. A ¼" dowel should be formed on the tops of the legs to fit into holes in the glass. Taper the feet on three sides, and cut the bottoms parallel to the joint surfaces. Round all parts of the legs with plane, file, and sandpaper, leaving the inner sides flat. For a better match at the joints, delay rounding the adjacent sections until after assembly and gluing.

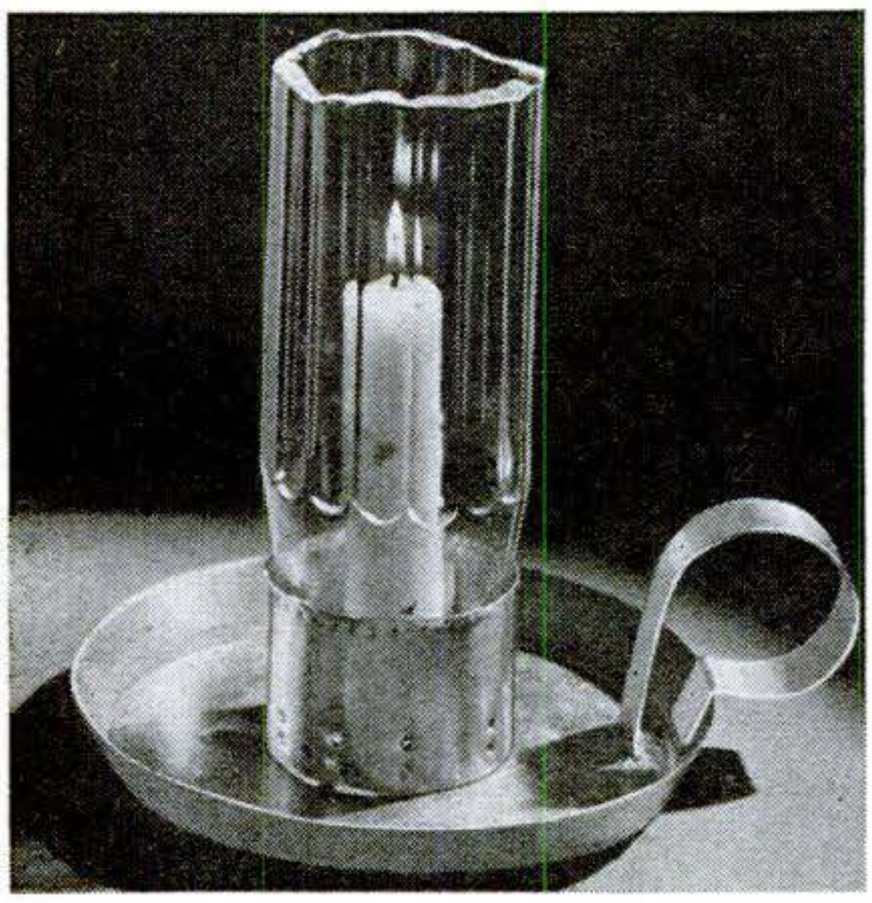
After the center ring has been cut out, sand four flats on the edge to fit against the legs. If you use solid stock, locate the flats so that the four spline slots cut into them will all cross the grain of the ring. Round all edges except at the flats.

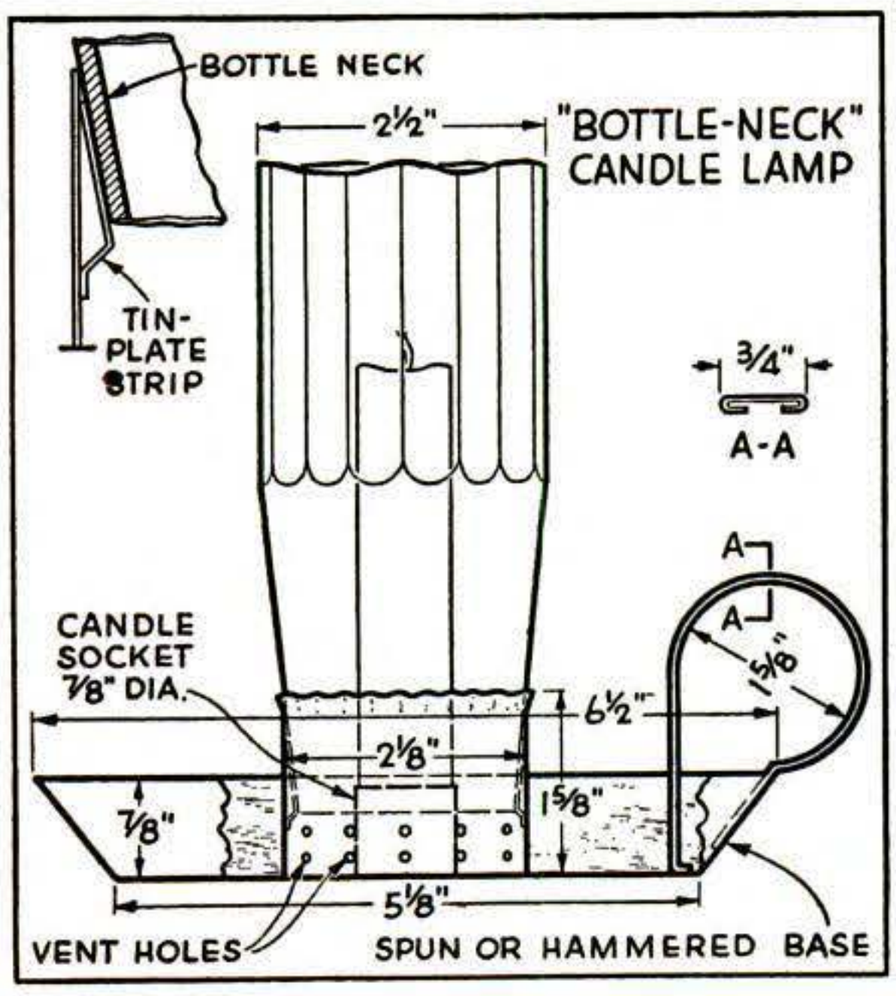
Make the splines from ¼" plywood, cutting them slightly larger than the slots. They are worked flush after gluing. Assemble with synthetic-resin glue and clamp the sides of the legs across the splines. Since the shape of the pieces prevents application of clamp pressure to all parts of the joint, a snug fit is important.

When the glue has set, do the final shaping of the rounded surfaces, and finish as desired. The table illustrated, made of birch, was simply varnished. One coat thinned half-and-half with turpentine was followed with two full-strength coats and an oil-pumice rub.

The top is a ⅜" thick plate-glass circle with polished edge. Holes for the leg dowels should be located accurately, using a full-size pattern made by inverting the table on a sheet of paper and marking the exact location of each dowel.

Ketchup Bottle and Tin Can Supply Materials for Candle Holder

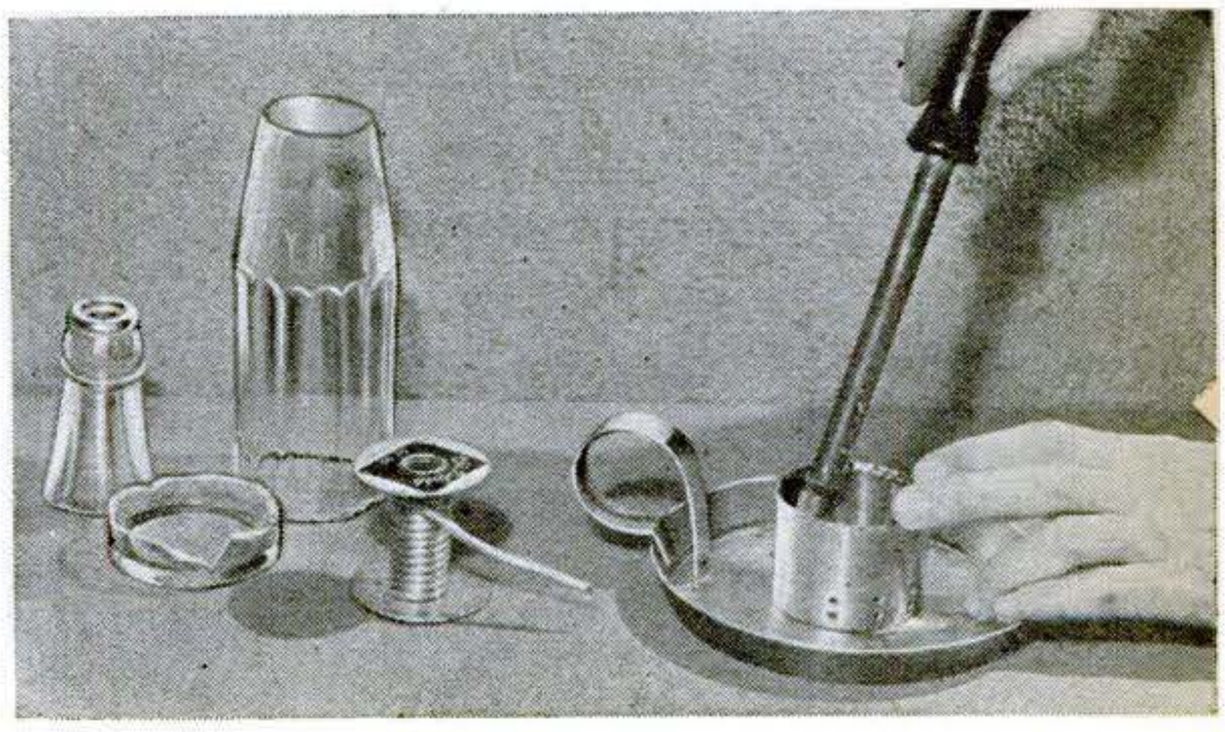




NOTHING but scrap is needed for this hurricane lamp. The base is made from a tin can, and the chimney from a ketchup bottle.

Cut away the bottom and part of the neck of the bottle by scoring around the outside with a glass cutter and tapping inside with a bent rod. Jagged edges are smoothed by a file wet with turpentine, and with abrasive cloth.

For the base, hammer a 6¾" tinplate disk over a wooden form. The base might also be spun to shape on a lathe—or an inexpensive tin skillet could be converted into a ready-made base by shortening the handle and bending it into the finger loop. The handle, candle cup, and bottle-supporting ring are made from strips of tinplate bent and soldered. To provide a snug fit around the tapering bottle neck, solder three or four spring strips inside the supporting ring. Punch two rows of holes near the bottom of the ring for draft.—ERVIN WALTERS.



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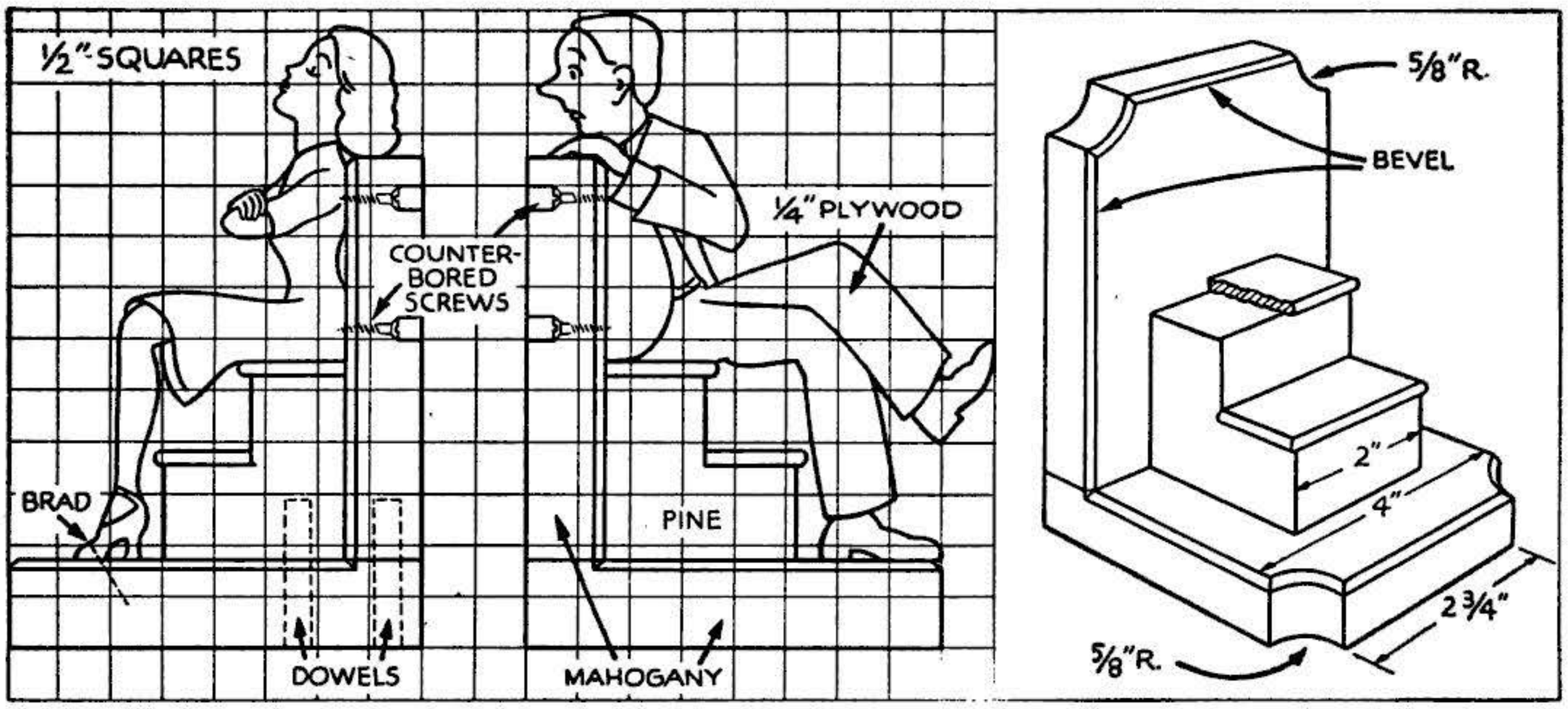
Bride-and-Groom Book Ends Will Please Newly Married Couple

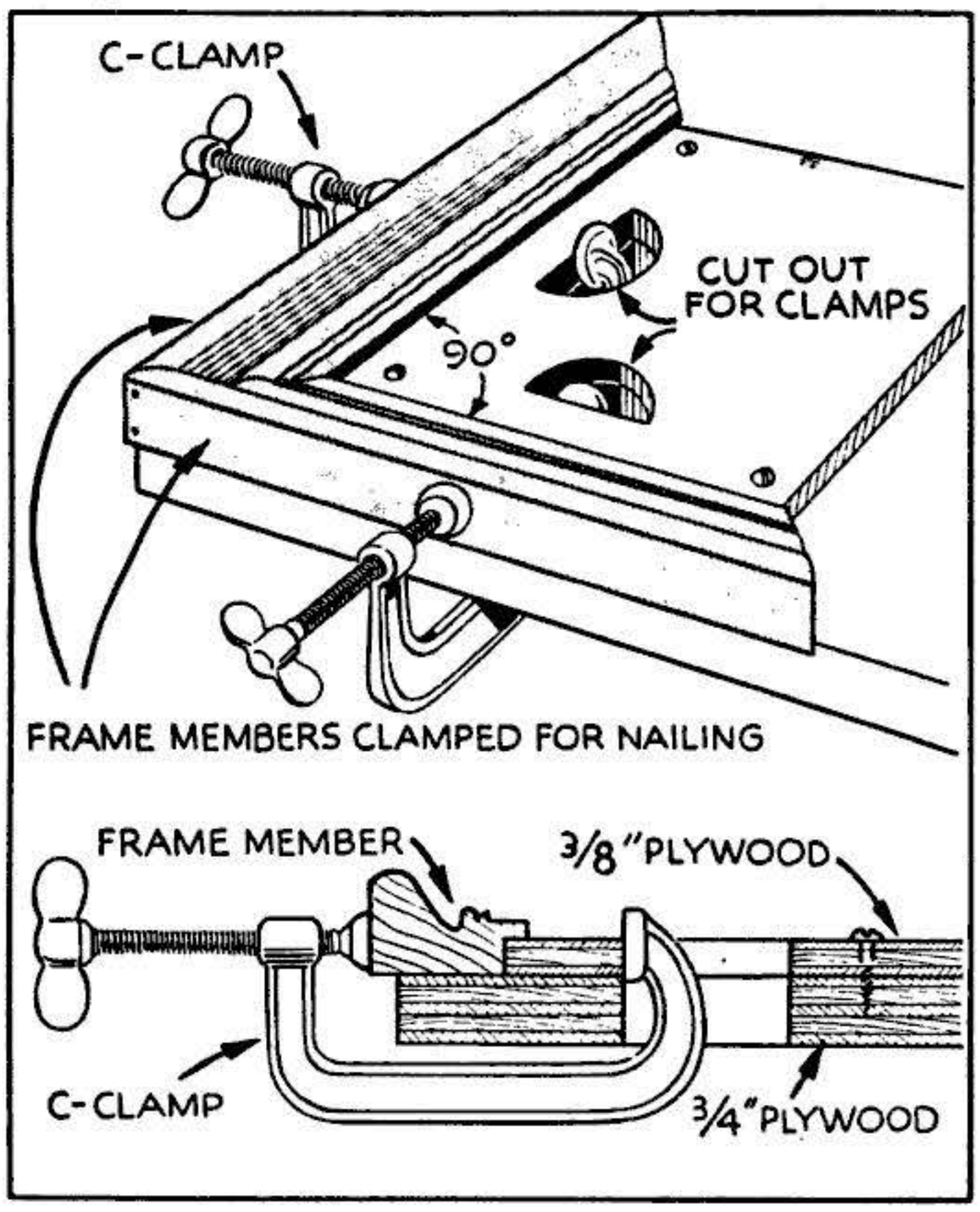


NEWLYWEDS often receive several duplicate gifts, but you can be sure yours won't be in that class if you present a pair of these bride-and-groom book ends.

The figures are scroll-sawed from ¼" plywood and the details painted in. Use flesh tints for the faces and hands and the girl's legs. Give her red lips and dress, black shoes, and golden yellow hair. For the man, black hair and shoes, blue suit, and white cuff, collar, and socks are a good combination. Paint the steps white, but leave the treads in natural wood, smoothly sanded and waxed. Make the base and back of polished mahogany.

Bevel the front and top edges of the base and back, and round the edges of the stair treads. Assemble the base, back, and stairs with dowels and glue. Attach the figures with small screws counterbored and plugged over and a brad driven through the shoe into the base. Sheet rubber cemented to the bottom of each book end will prevent slipping on polished surfaces.—HI SIBLEY.

Jig Assures Square Corners When Assembling Picture Frames



THIS jig will provide perfect corners and a square assembly when you are nailing together the pieces of a picture frame. If the clamp screws are not so long as to interfere, the jig also can be used to cut saw kerfs for slip tongues.

To build it, you will need two 6" C-clamps, a piece of ¾" plywood about 12" wide and any desired length, and a piece of ⅜" plywood 8" square, or the inside size of the smallest frame you are likely to make. After squaring the ⅜" plywood accurately, screw and glue it to the larger piece, squaring it near one corner to leave a 1" rabbet each way. Then cut two semicircular holes to admit the ends of the C-clamps, making the straight edges parallel with the outside edges of the small piece of plywood.

When you use the jig, place the inside edges of two frame members in the rabbet, adjust until the miters meet, and clamp the pieces in place.—SAM J. SCHLAPPICH.

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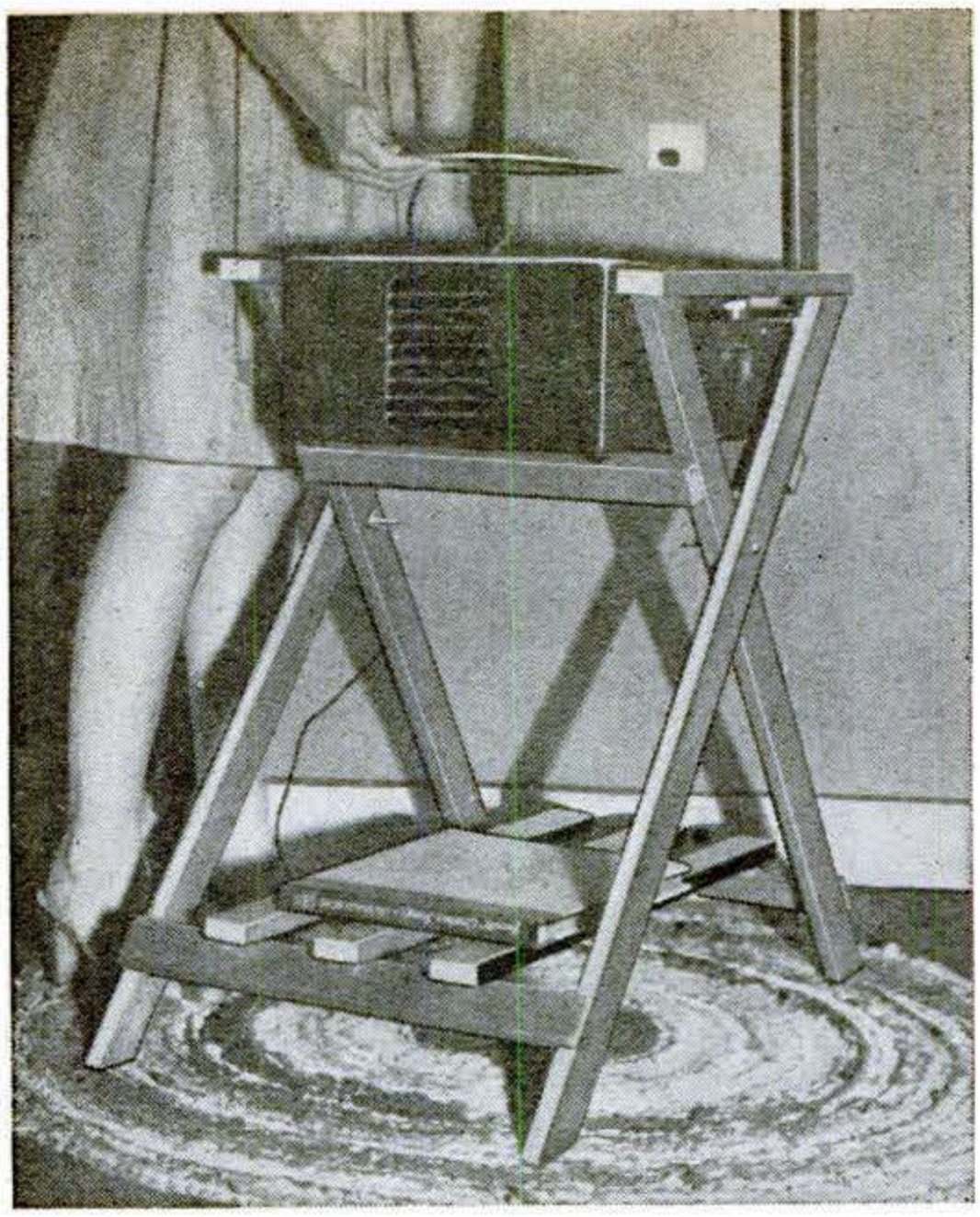
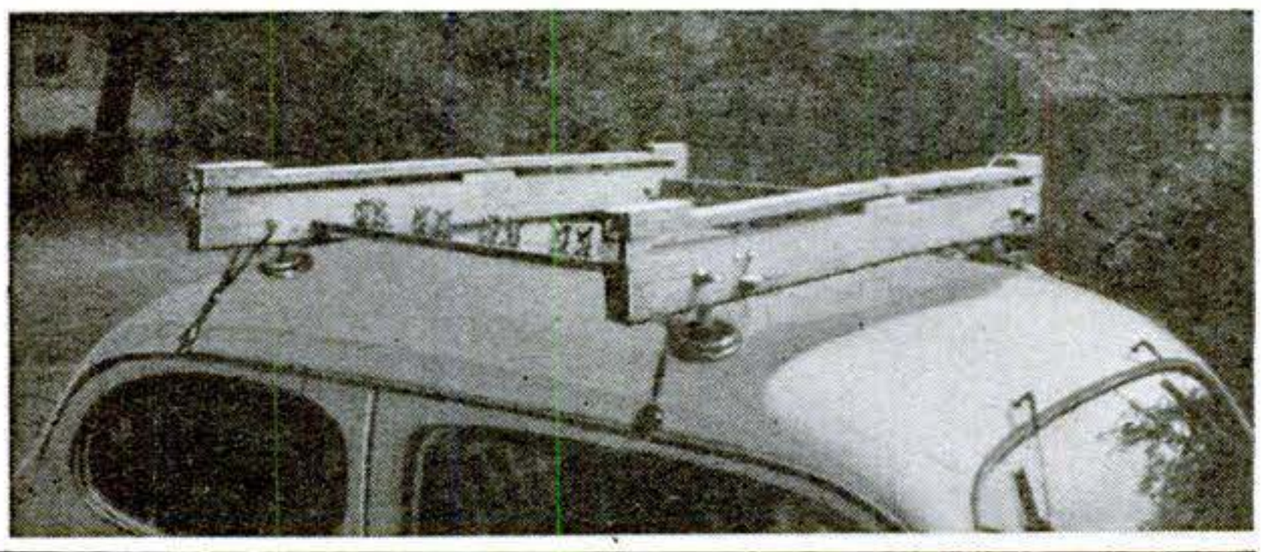


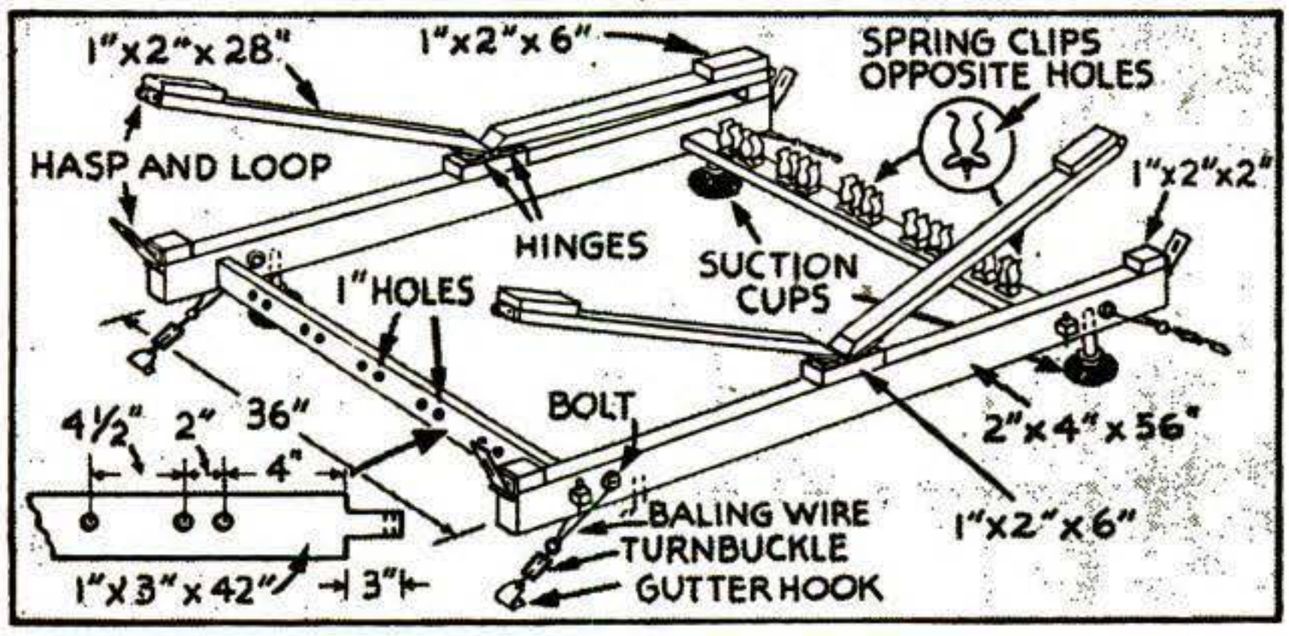
Simple Wood Stand Holds Portable Phonograph or Serving Tray

JUGGLING lamps and vases to clear a space for the portable phonograph won't be necessary with this stand that holds a record player at just the right height and has a shelf for albums. The stand might also be used to support a large serving tray at the dinner table.

All parts are 1″ by 2″ stock. Cut four pieces 35″ long and in each drill a hole 23″ from one end. Bolted together in pairs, these pieces form sturdy sawbuck sections. Connect them 7″ below the top with supporting pieces about 16½″ long—enough for the phonograph and its carrying handle. Cross members 16½″ long on top add rigidity.

The shelf is made from two lengths fastened between the sections about 4″ from the floor with three pieces nailed on top. Saw the bottoms of the legs at an angle so that they rest flat.—EMILE C. SCHURMACHER.





Multipurpose Ski Rack

A VERSATILE car-top rack designed primarily for skis and poles will also carry small boats, lumber, or almost anything else too bulky to fit inside an automobile. Since the connecting pieces are held only by pins, it can be disassembled easily for compact storage. The rack accommodates five pairs of poles when they are interlocked by putting the shaft of one through the snow ring of the other, and has hinged top arms fastened with hasps that can be padlocked. Before following the dimensions in the drawing at the left, check them against your car measurements.—HENRY K. FITTS.

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CIVIL WAR CANNON MODELED IN BRASS

By A. F. HOFMANN

SATISFYING both in the making and on the mantel, this gleaming brass model of a 19th Century cannon is a fine project for winter evenings. The one pictured in the photos and plans on the facing page was carefully scaled from a real artillery piece of the Civil War. (Pictured above, both assembled and broken down, are similar models executed in different scales.) A metal-turning lathe is the only essential power tool; a drill press and a miller are useful but not indispensable.

Except for the steel axle, all parts are made of brass. Turn the hubs, felloes, and tires to size, making the inside diameter of the tires about .001″ less than the outside diameter of the felloes. If on assembly after adding the spokes you find the parts will not go together in a nice press fit, try cooling the felloes in a refrigerator and heating the rims with a torch.

A convenient way to lay out the spoke holes is detailed in the three numbered steps in the drawing. Use a ¼″ paper strip just long enough to go around the felloe. In order to get true-running, concentric wheels, an assembly jig turned of 1½″ brass or aluminum stock is desirable. Use first a centerdrill and then a ⅜″ drill to produce a hole just deep enough for the hub to fit in with the edge of the spoke holes flush with the end. The felloe is slipped over the outside of the jig and the .093″ spokes are then tapped in place.

Turn the barrel from 9/16″ or 5/8″ rod. If you are a superconscientious modeler, you can drill the ⅛″ bore to the scale depth of 3⅝″, although a depth of 2″ will be ample for appearance. Steady the barrel during turning with a 1/8″ rod held in the tailstock chuck and run into the bore. Drill the touch hole and the holes for the 1/8″ trunnions. If the latter are slotted with a jeweler's saw and fitted into fairly snug holes in the carriage, friction will hold the barrel in any desired position.

Cut the trail from 3/16″ brass sheet, bending and notching as shown, and then soldering to the carriage frame. The trunnion holes in the carriage arms must be drilled to exact depth to avoid side play on assembly. Be sure to put the barrel in place on the carriage before soldering on the second arm.

Drill 1/16″ dimples in the ends of the steel shaft, assemble the wheels and carriage, and lightly peen the ends of the shaft to retain the wheels. Remove all visible solder, polish the brass to a high finish, and give the cannon a coat of lacquer.

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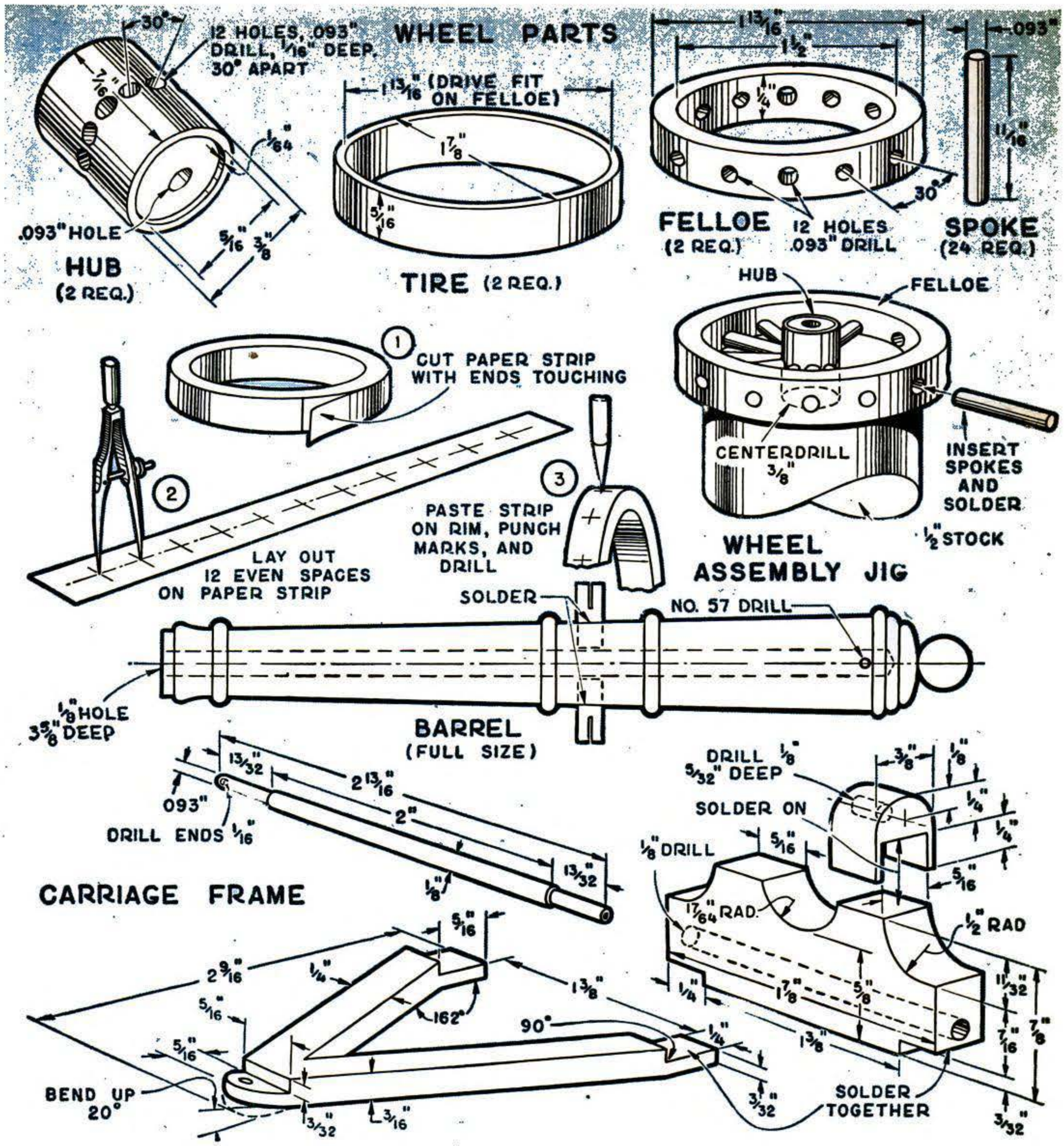
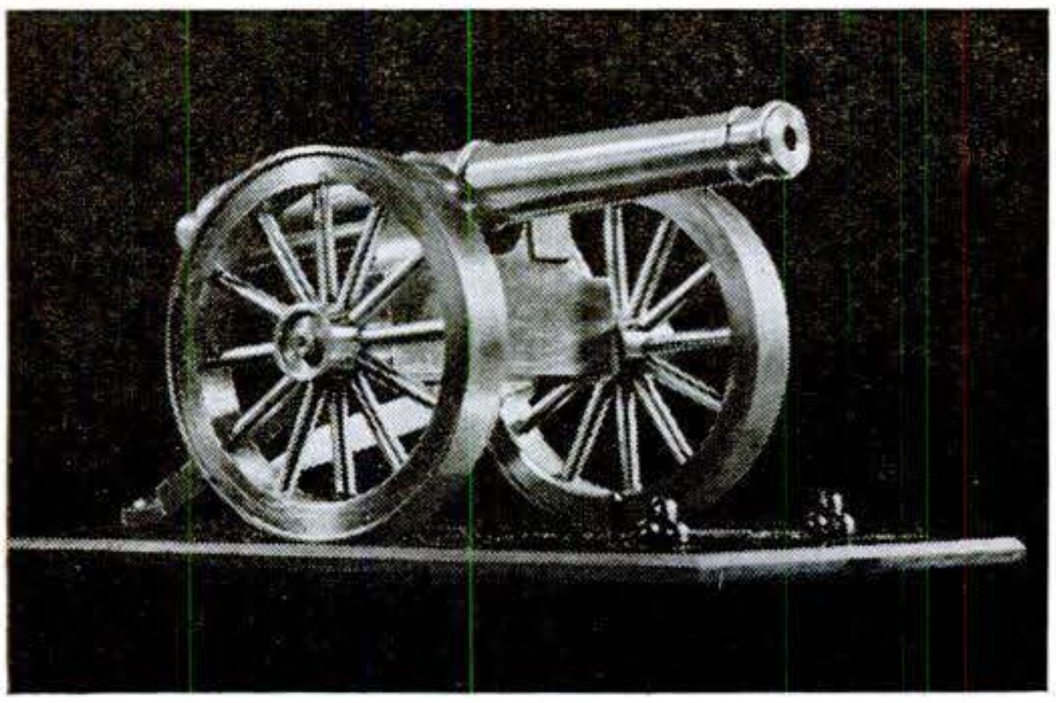
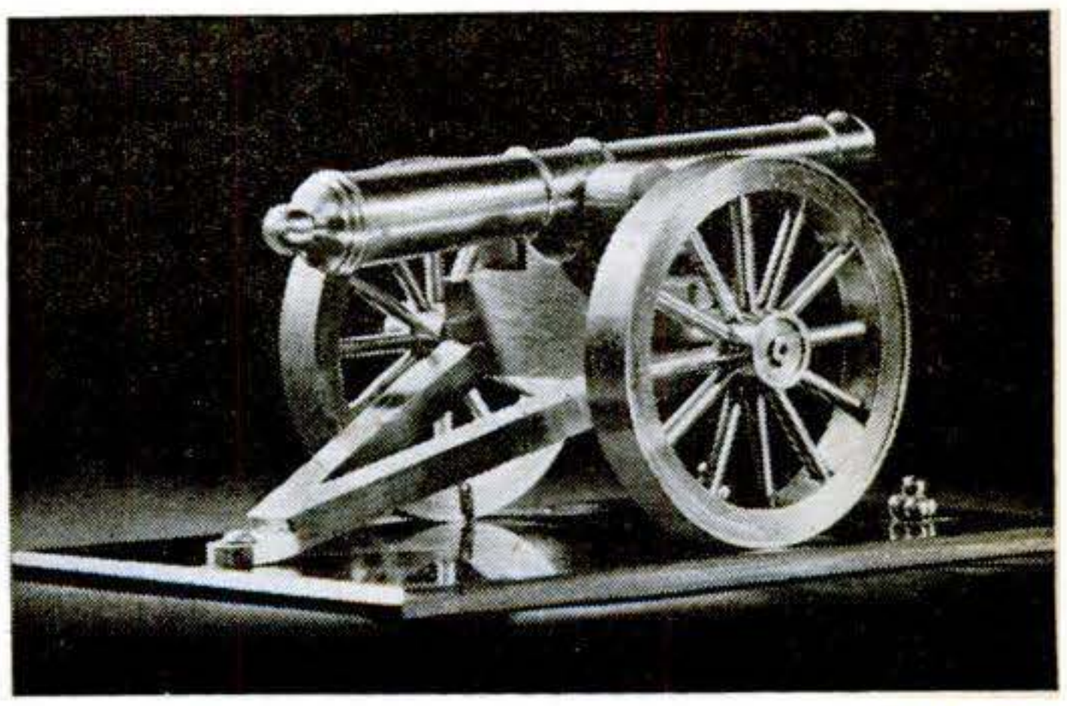


In order to make one of the cannonball pyramids, cement or solder together four 1/8" bearing balls.

Plans for this attractive brass model were copied from old drawings of a Civil War artillery piece.





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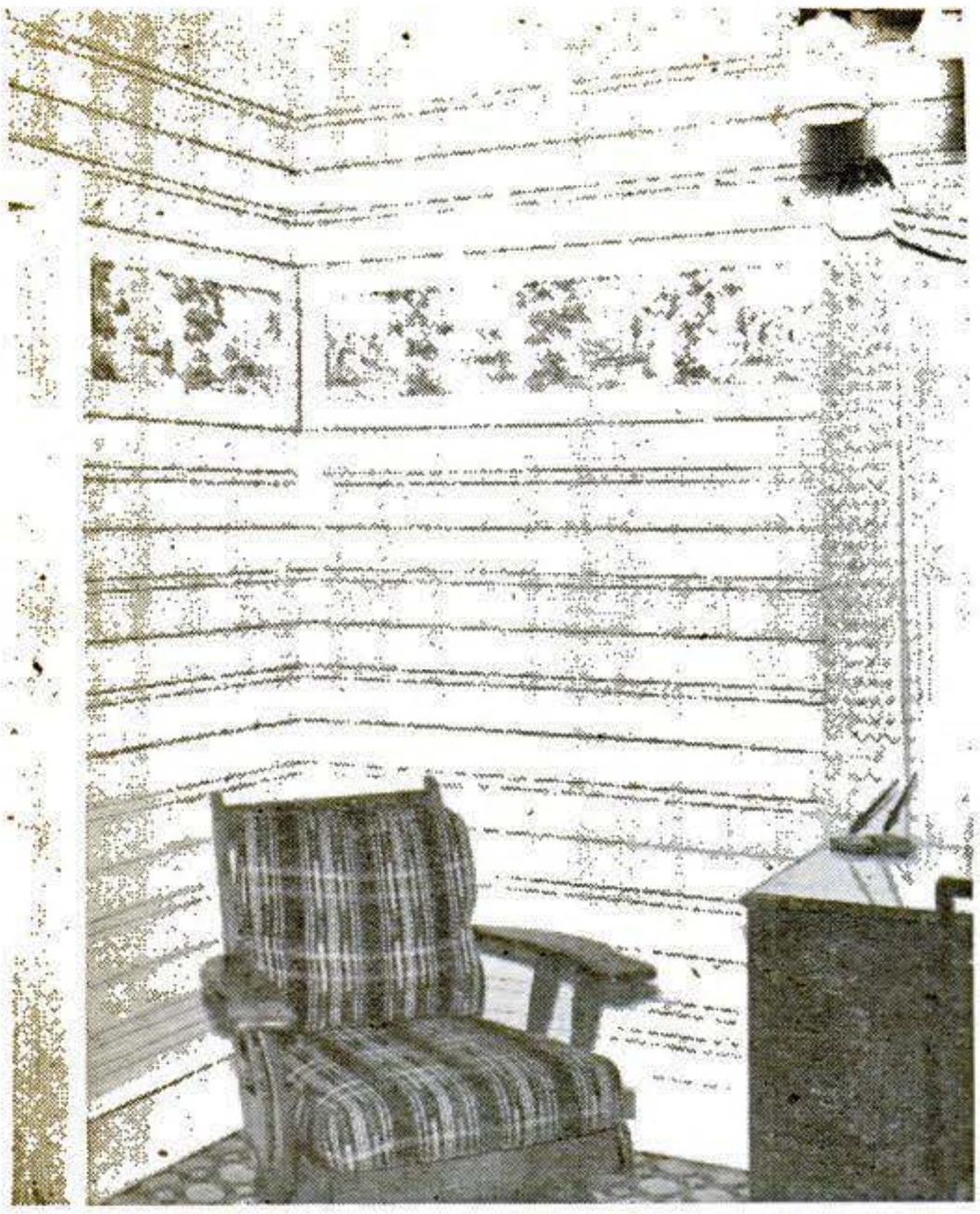
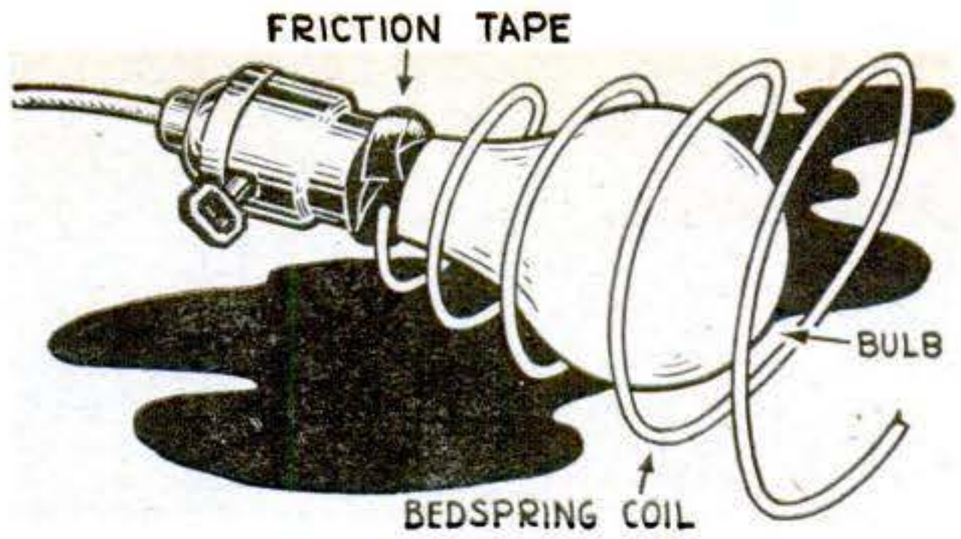


Scenic Panel and Stripes Add Charm to Wallpapered Room

Two wallpapers were used for the paneled effect in the room shown above—one scenic, the other striped, and both moderately priced. Colors were chosen to blend.

Cut the scenic paper in blocks to make a continuous horizontal design and apply it along a guide line measured from the ceiling. This line should be just far enough from the ceiling for one or two widths of striped paper put on horizontally to fill the space. The scenic blocks show best just above eye level. Reverse the stripes below the panel and lap each piece over the one above to minimize edge shadow. Corner strips complete the panels.—A. G. Tarby.

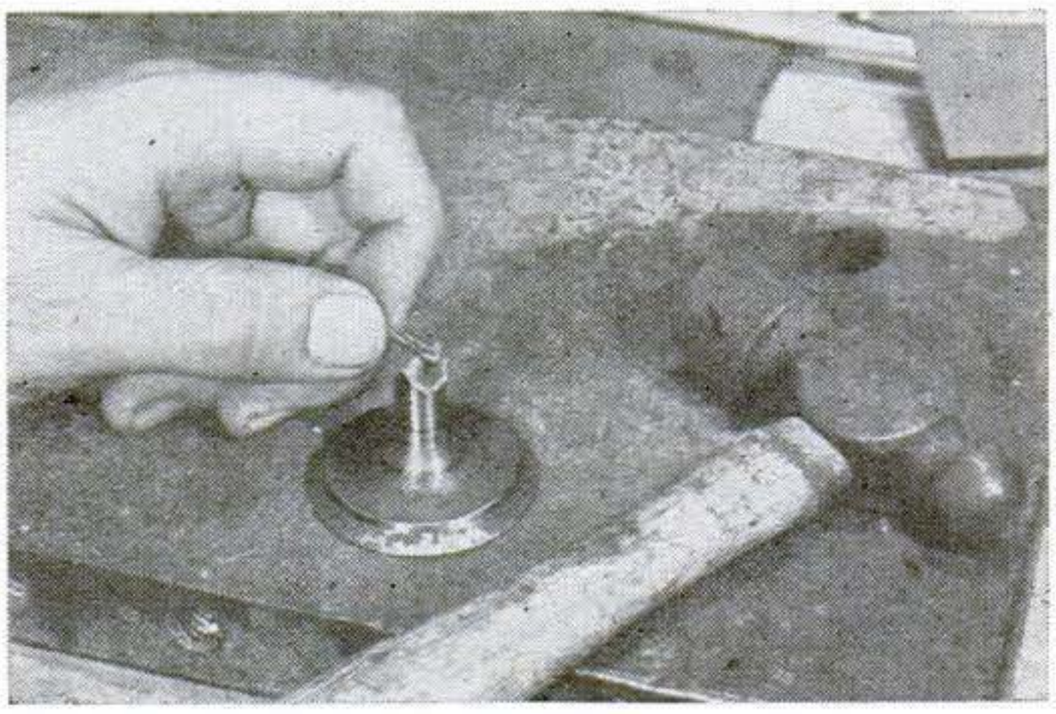


Bedspring Coil Protects Lamp

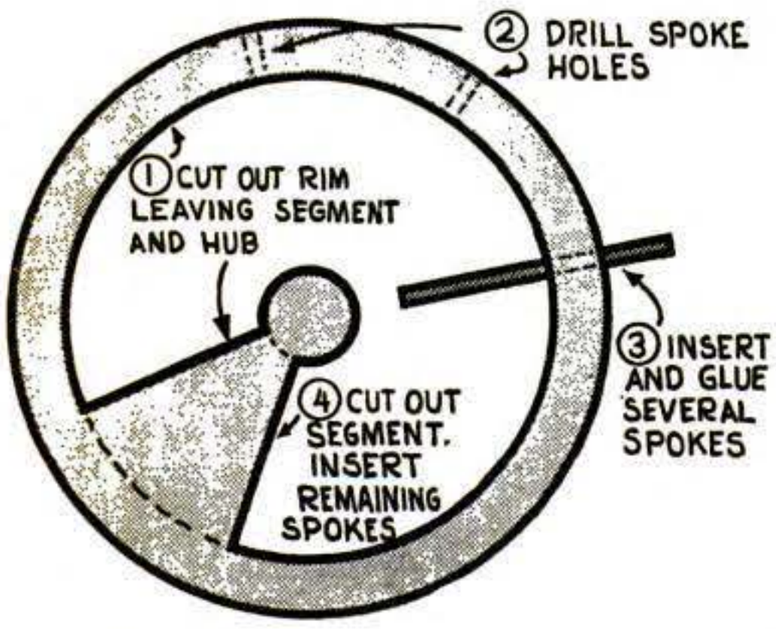
As a guard for a shop electric-light bulb, try using one of the coils from an old bedspring if a regular shop-light guard is not at hand. Slip the small end over the socket and wind with a few turns of friction tape to hold it securely; then screw the bulb back in place.—Edward H. Stutz.

Auto Valve Makes Bench Hardy

Cut short, shaped, and hardened, an old auto valve is useful on the bench as a small hardy or blacksmith's fuller on which metals can be hammered, grooved, and spread. Sharpened to a chisel edge, it is a good cutting-off tool.—Ronald J. McKenzie.



Keeping Hubs Aligned While Putting Spokes in Model Wheels



Almost every modelmaker finds it difficult to keep the hubs of small wheels centered when gluing in spokes. Here is a method that provides an exactly true hub and a finished wheel without the slightest wobble.

Both the rim and hub are cut from the same piece of stock with a section joining them left in temporarily. The rim is then drilled for spoke holes, and several spokes are inserted and glued to the rim and hub.

When the glue has dried thoroughly, the piece between is cut out. The glued spokes will hold the hub in alignment while the remaining holes are drilled and the other spokes put in.—Charles J. Fraser.

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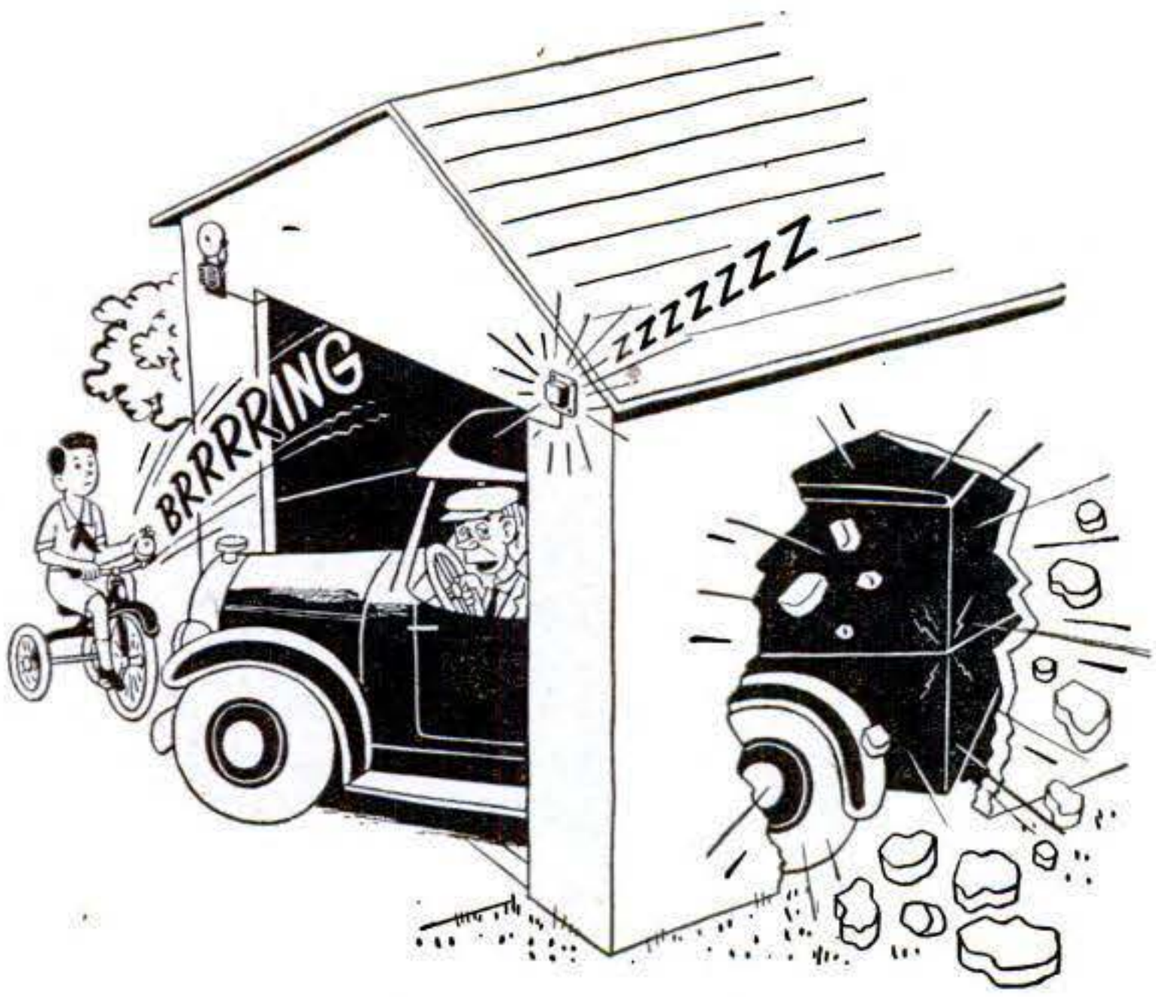
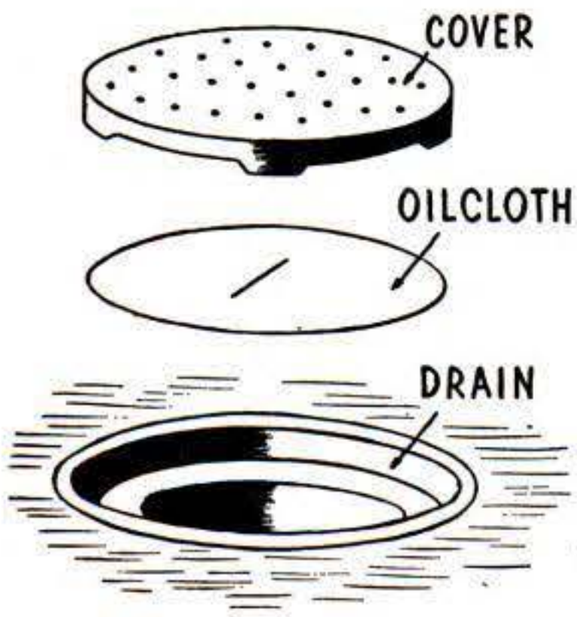
WHAT'S YOUR INGENUITY QUOTIENT? IQ

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.

STEERING BY SOUND. Since I frequently have to back a big, blind hearse into a narrow garage, I worked out a way of using my ears as eyes. If I get too far over one way, the hearse hits a cord placed horizontally a few inches from one side of the garage, closing a contact and ringing a buzzer. If I get too far to the other side, a second string rings a bell. Now I manage fine, provided that buzzing bees or kids with tricycle bells stay away.—V. G. CLEMENTS.



WARM WATER NEVER FREEZES, I hear, so I decided to provide a blanket for the water that sometimes freezes up the drain trap in front of my garage. First, I lifted out the perforated cover of the trap with a screwdriver. Then I cut a piece of oilcloth to fit down into the round depression, made a slit in the center, and put back the cover with the oilcloth under it. In winter, the oilcloth prevents the drain from cooling off so quickly and freezing the water there. When it rains or water from melting snow goes through the holes in the cover, the slit opens enough to let it drain through and run off.—G. L. FERGUSON.



TWO-HEADED SCRAPBOOKS are better than one if you find yourself in the fix I did on clipping an item and then discovering another on the opposite side I also wanted to save. I solved the problem by cutting a hole in one page of the scrapbook and then taping the clipping over it.—RONALD LINDER.

THE YANKS ARE HERE, all over my house. They're the people who insist on yanking an electrical cord, instead of gently pulling the plug. But I'm ready for them now. Tired of rewiring plugs, I melted and poured sealing wax into the hollow of each one after the wires were connected.—ALFRED NORMAN.

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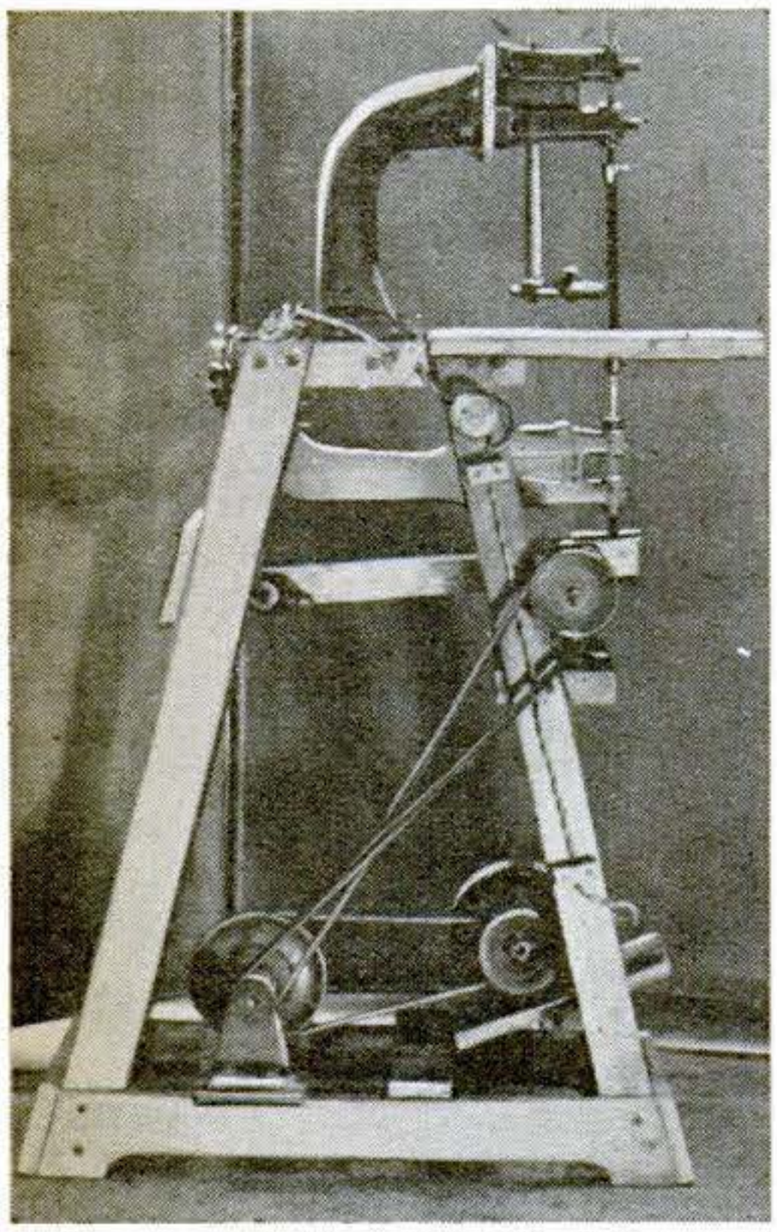
CRAFTSMEN at WORK

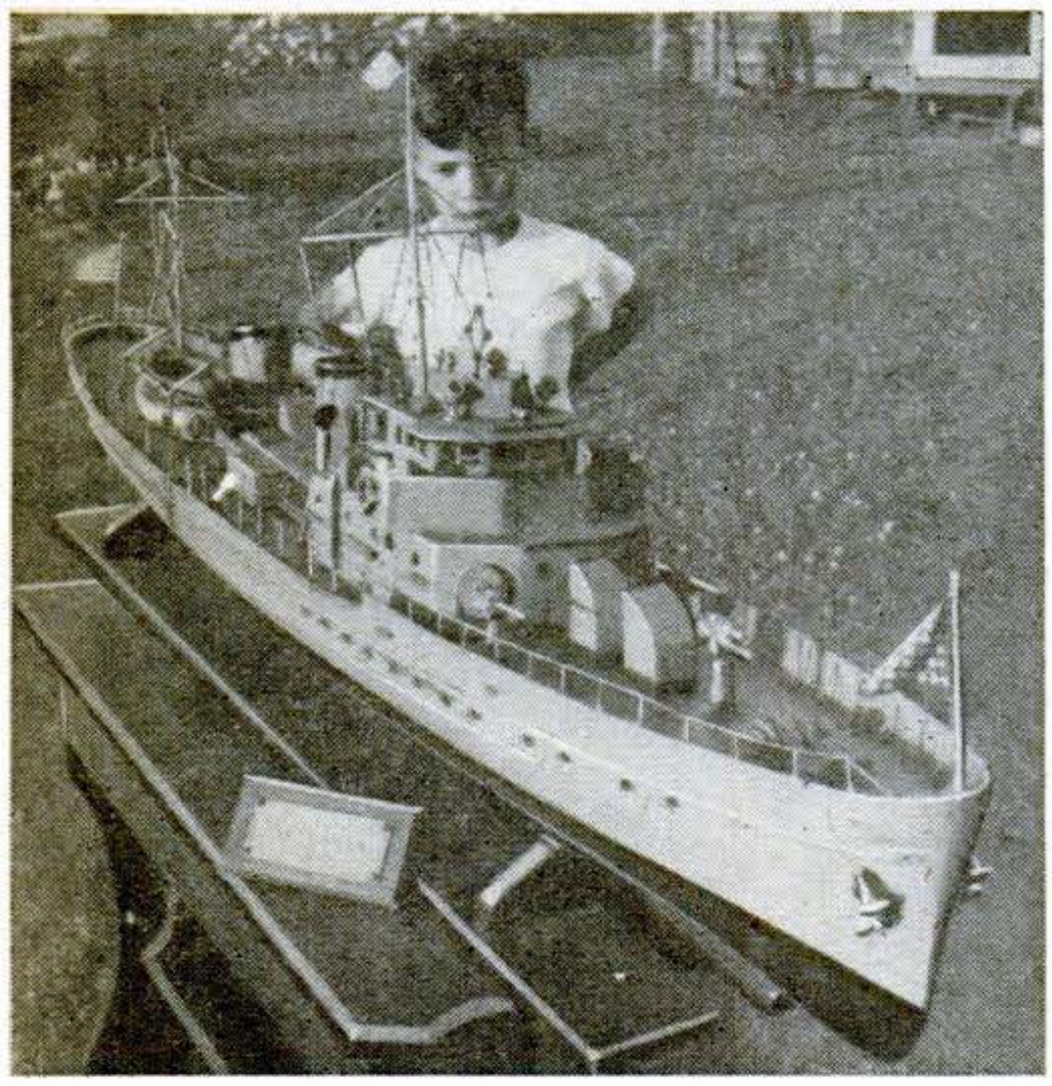


THIS PILOT BUILDS MODEL PLANES in his spare time between flights on the Kansas City-Washington run for TWA. He is Capt. Thomas L. Wardlaw, and he uses his flying knowledge in designing his own models. Here he is shown with his "K. C. Terror," a high-wing monoplane with a 62″ wingspan and 27-oz. weight.

BROKEN BANDSAW BLADES too short for further brazing sent Francis S. Root, of Northampton, Mass., thoughtfully to his junk box. The result was the power jigsaw and hacksaw shown at left.

Two different cast-iron horns from old phonographs form upper and lower arms. One plunger is held by an air-rifle spring; the other is actuated by an eccentric. Skate wheels provide ball-bearing smoothness. The saw takes 8″ lengths of bandsaw blade.

ENLARGED FIVE TIMES from POPULAR SCIENCE plans, this 5′ long self-propelled model of the Coast Guard patrol boat *Atlanta* is complete to such details as chart table and binnacle in the wheelhouse. John H. Dodge, of Kenyon, R. I., built it.



WOODEN HORSES ARE THE HOBBY of George Wilkins, of Chappaqua, N. Y., but they are too small for riding. Wilkins, a cavalry veteran of the first World War, carves miniature equine figures from teakwood, black walnut, white pine, maple, cypress, and mahogany. His collection contains more than 100 carvings.

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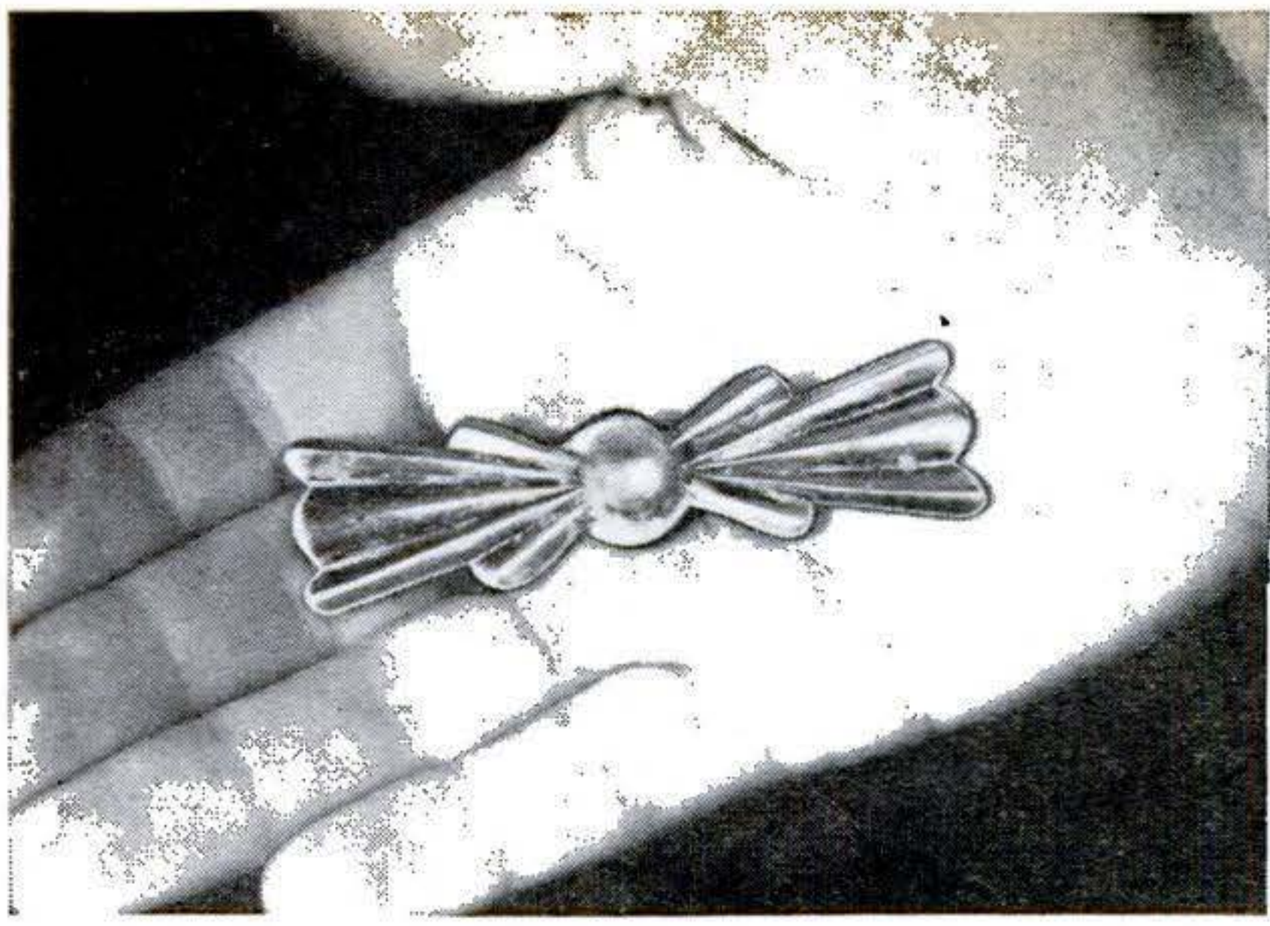
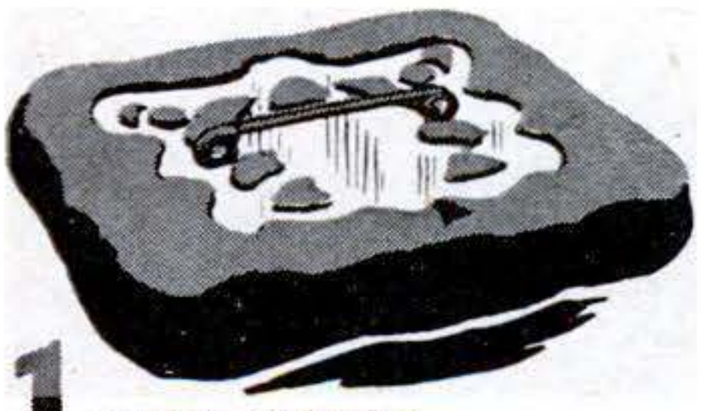


Molding SILVER Jewelry

DENTAL amalgam, that alloy of silver and mercury dentists use for filling teeth, is an excellent material for making jewelry in the home workshop. With it you can duplicate admired pieces, or you can make ring settings, brooches, watch charms, pendants, earrings, and other pieces of your own design.

Besides an ounce or two of amalgam, which you should be able to get at your dentist's or a dental-supply house for about $2.20 an ounce, you will need 1 oz. of mercury to mix with it and increase its workability. You will also need a little plaster of Paris, modeling clay, dental wax, and powdered pumice. This is sufficient to make a number of pieces of jewelry—at a cost of no

REPRODUCTIONS IN SILVER can be made by packing amalgam into a wax mold formed around the original. In the photo above, such a piece is cemented to plastic. Model-airplane cement will hold it.



1 PRESS OBJECT INTO SOFT WAX

2 PACK COOLED MOLD WITH AMALGAM

3 HEAT WAX AND STRIP OFF

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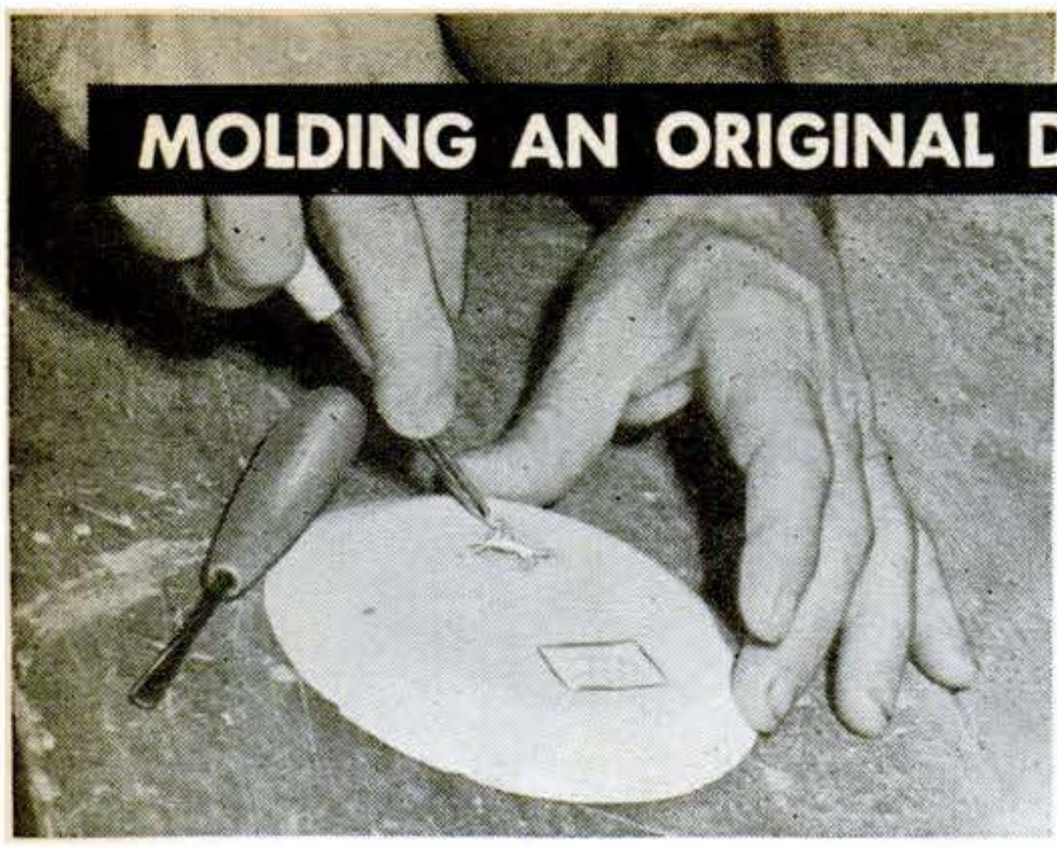
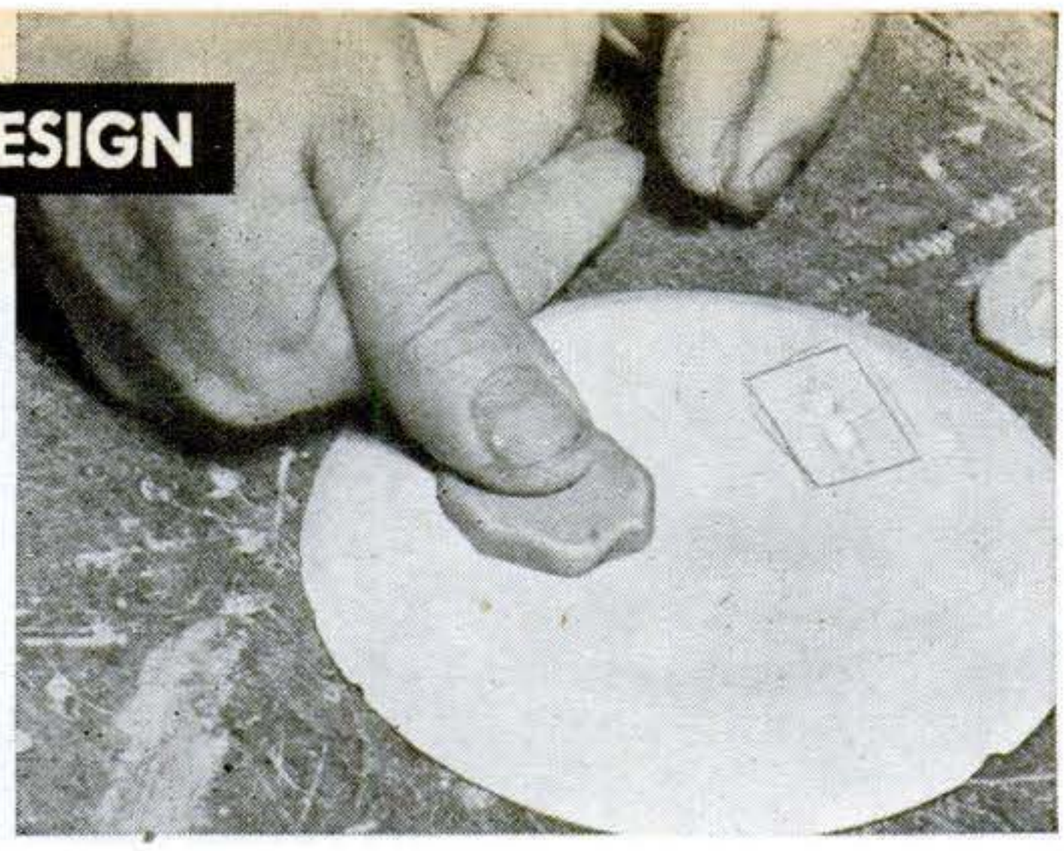
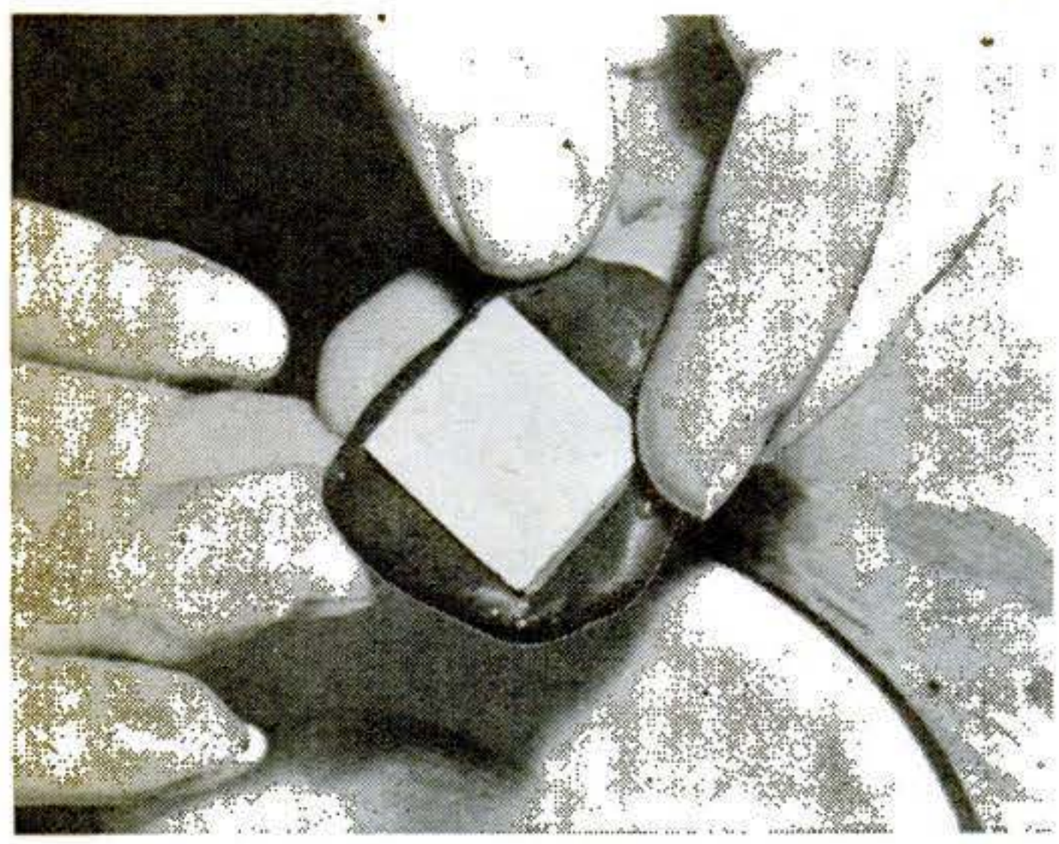
MOLDING AN ORIGINAL DESIGN



1 Plaster of Paris is mixed with water and cast in a greased pie tin. When it has dried, the design is tooled in with chisel, knife, or grinder.



2 Modeling clay is next forced into the design and allowed to dry a few minutes; then it is removed, and the edges are trimmed to a bevel.



4 Dental wax, softened in hot water, is pressed around the clay, hardened in cold water, and carefully pulled off to become the final mold.

5 Silver amalgam is packed into this wax mold bit by bit until every corner is filled. The wax is softened by heat and the piece removed.

more than about 50 cents or a dollar each.

For an original piece, mix some of the plaster with water and allow it to set until firm and only slightly damp. Then cut the design with an etching tool, linoleum-block cutter, fine chisel, jackknife, or motor-driven hand grinder. For a reproduction, simply press the model into the damp plaster to make a mold.

When the plaster has dried, mix modeling clay (the kind that can be fired) with water to a stiff substance, push it firmly into the mold with the thumb, and let it dry to the hardness of soap. Remove from the plaster and cut the base or background of the clay cast to desired form, beveling the edge, for instance, so it can be held by prongs if the piece is to be set in a ring; then sand the back smooth on fine sandpaper

Let the finished cast dry thoroughly in the sun, and then bake it to the approximate hardness of brick. This is best done in a pottery kiln, but an ordinary kitchen oven or a small brick furnace fired with charcoal will do. Two or three hours at 350 to 500 deg. should be sufficient. The lower temperature is about the limit in an oven.

Saturate the cast with light oil when it has cooled and press it into dental wax previously softened in hot water. Cool the wax in cold water and remove it carefully for use as a final mold.

Pieces to be reproduced without a base, such as charms and pendants, or those to be mounted on plastic or other bases, can be molded directly in the wax without the plaster and clay steps. Another way to avoid oven heating is to use dental investment

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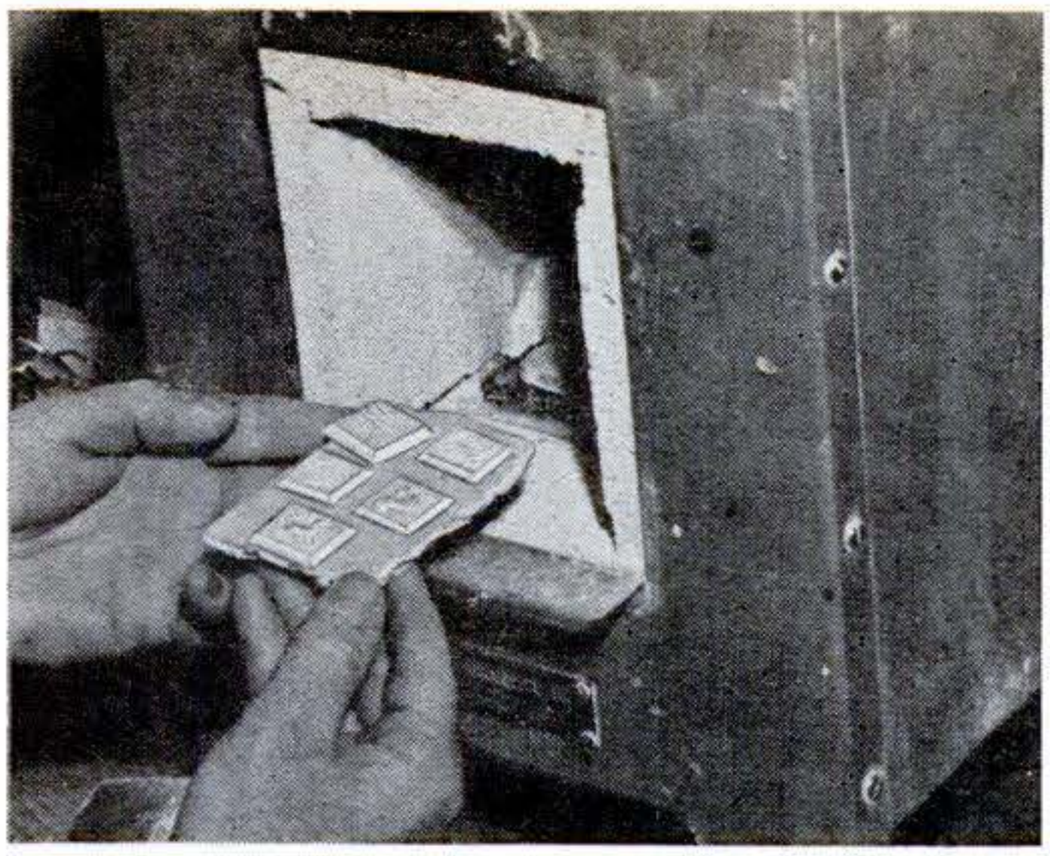


3 The clay form is then fired to the hardness of brick. A pottery kiln is used here, but a kitchen or small charcoal oven will serve.

6 Brisk polishing with powdered pumice and a stiff brush works up a high luster. A coat of clear lacquer will retard tarnishing.

cement instead of modeling clay. This cement hardens without heat, but it is somewhat harder to work.

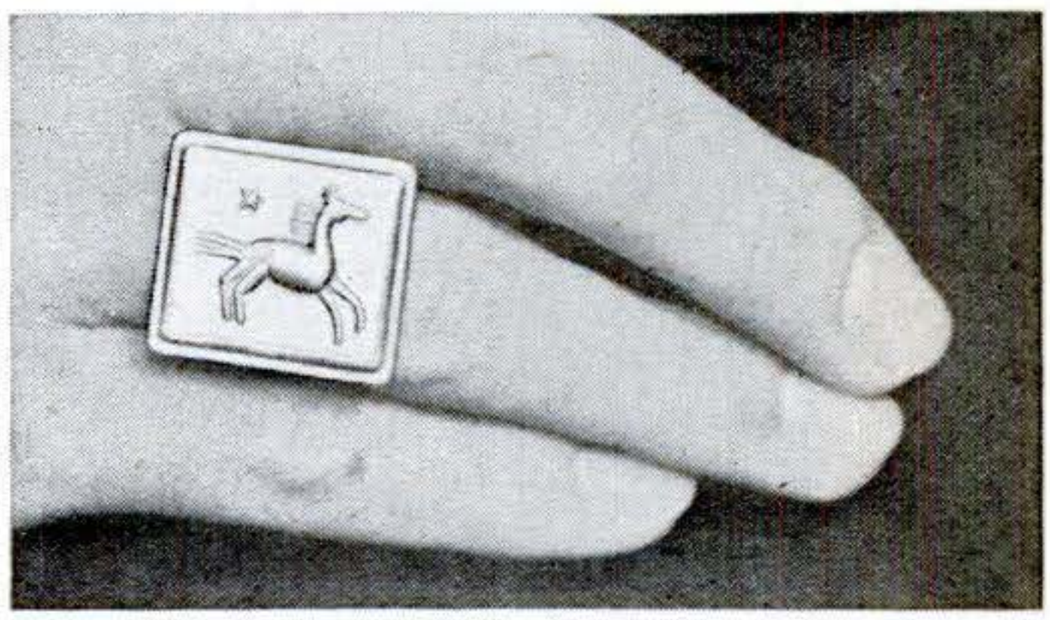
When the hardened wax mold has been prepared, mix a very little mercury in the dental silver amalgam to make it pliable. Squeeze out excess mercury through twisted cheesecloth, and then, with the amalgam the consistency of stiff putty, press a little at a time into the wax mold. Use any small blunt instrument and pack amalgam into every corner. Let it set overnight; then heat the wax and pull it off.

Silver amalgam can also be packed directly into the first plaster mold, eliminating all the intervening steps, but only when the piece is not to have its own backing or is to be cemented to plastic or the like. It will be necessary to smooth the back and edges carefully, using a spatula or similar tool first and finishing with a fine file or garnet paper.

When the silver is first taken from the mold, it will be light in color and lusterless, with a look almost like that of clay. Brisk polishing, however, with pumice and a stiff brush will soon bring out its silver sheen. The amount of polishing controls the degree of luster. Like all silver, amalgam is subject to tarnish, but a little silver polish will restore its high luster. A coating of colorless nail polish or other clear lacquer will protect its finish.

Beveled-edge settings may be placed in any ring having prongs of adequate size—a dime-store ring will do. Bend the prongs apart with long-nosed pliers, and then hammer them tightly over the setting with a punch and light hammer.

For a pendant or watch charm, the piece is strung on a suitable chain. Punch the hole for the chain in the clay cast before baking, or solder an eye on the finished piece with jeweler's silver solder.—R. De Witt Miller.



Here is the silver ornament set in a ring. Its beveled edges provide a firm grip for the prongs. Original designs are well suited for rings.

This heart-shaped pendant was molded directly in plaster of Paris and smoothed with garnet paper. The eye may be integral or soldered on.

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BOOKCASE
BUILT OF
SCRAP PANELING

By NORBERT ENGELS

THREE shelves for books and a deep bottom shelf tall enough to take record albums make this case an extremely useful piece of furniture for the room in which the family gathers for reading and music.

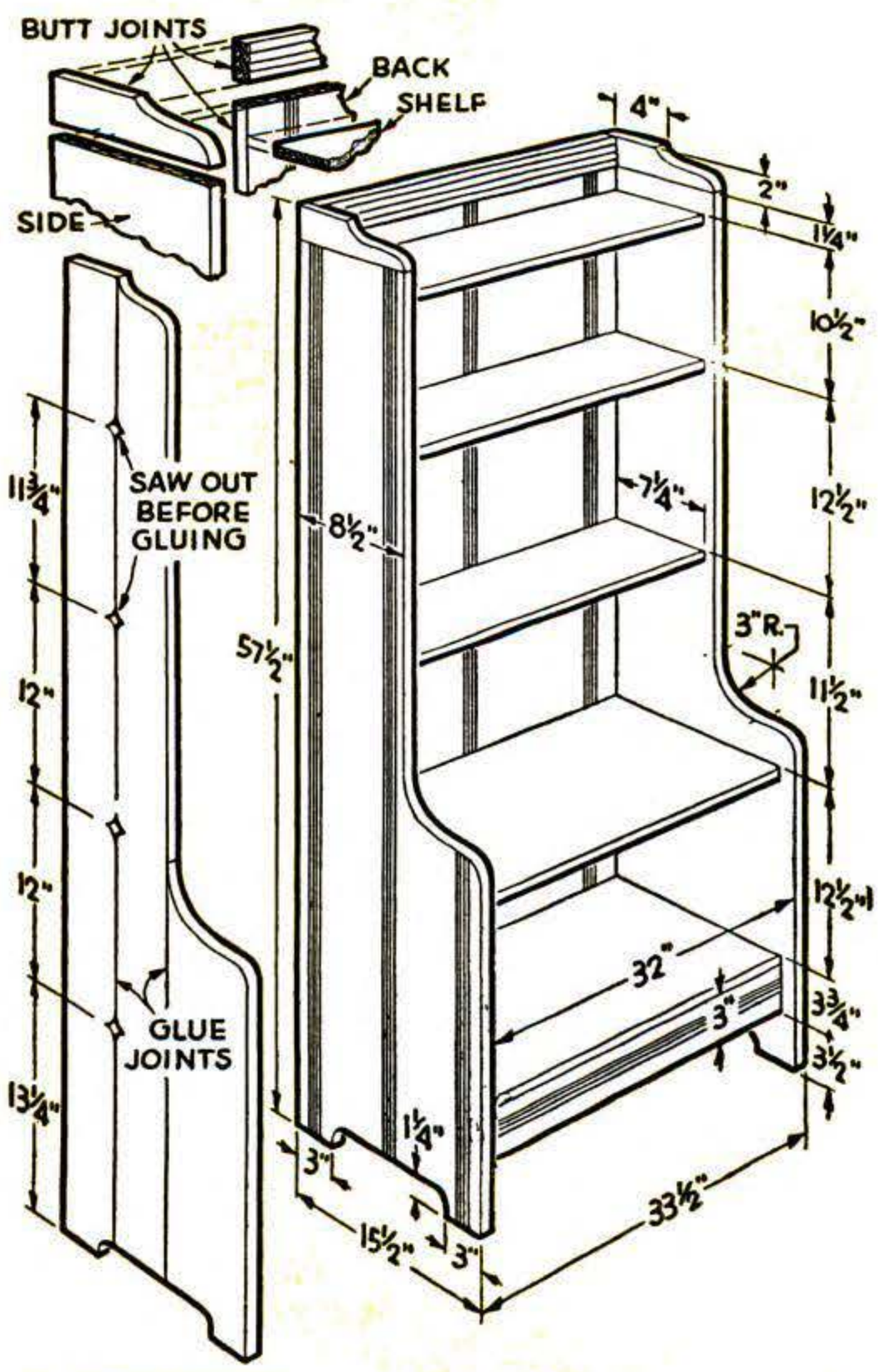
I discovered the original in a monastery and was given permission to reproduce it for POPULAR SCIENCE MONTHLY readers. The young seminarians had built it from scrap pieces left over from paneling the walls of their recreation room.

Though the three beads in the paneling are effectively used as a simple decoration

on the bookcase, there is no reason why the design cannot be changed to suit individual purposes, tastes, and available materials. For instance, the sidepieces and back may be made of plain boards or of boards glued up with a design cut in the joining edges. The back may be a single panel of plywood rabbeted into the back edges of the sides, or it can be eliminated entirely. Vertical partitions may be installed in the record shelf to separate groups of records.

The piece may be made entirely with the most elementary hand tools, a square, crosscut and scroll saws, a hammer, and a nail set being the only ones required. First cut the sides and shelves and assemble them with finishing nails driven through the sides. Set the nails and fill the holes with plastic composition wood. Nail the back to the shelves, and then saw out and nail in the top and bottom trim.

Several finishes are appropriate. The piece may simply be given the regulation coats of shellac and varnish, especially if the wood is knotted or has a pleasing grain, or a pickled-pine effect can be obtained with a coat of light gray wiped off lightly while still wet and then waxed. A staining wax in a maple or "driftwood" shade is also effective. It should be followed by two coats of ordinary paste wax.



ALTERNATIVE SIDEPIECE LAYOUT

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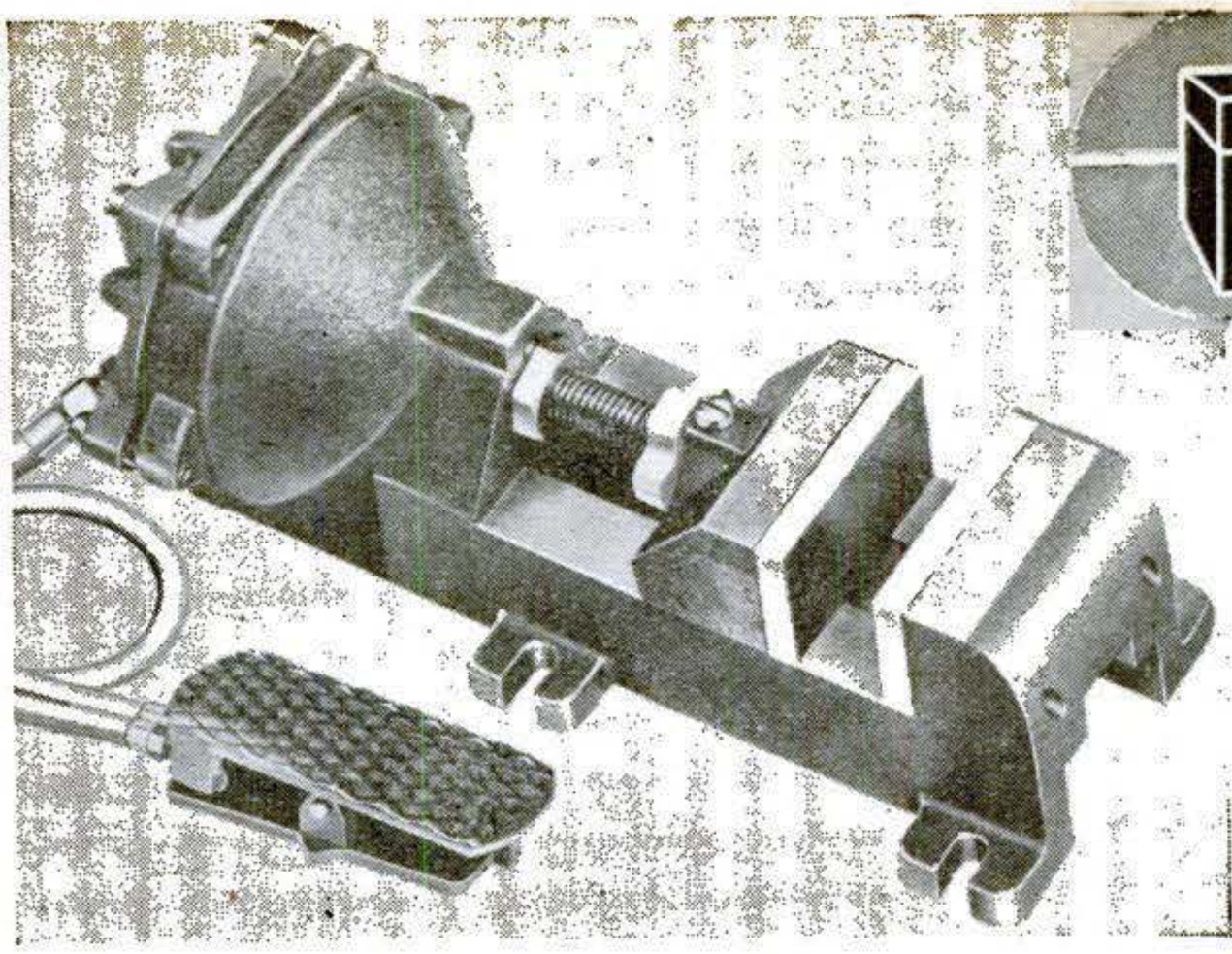
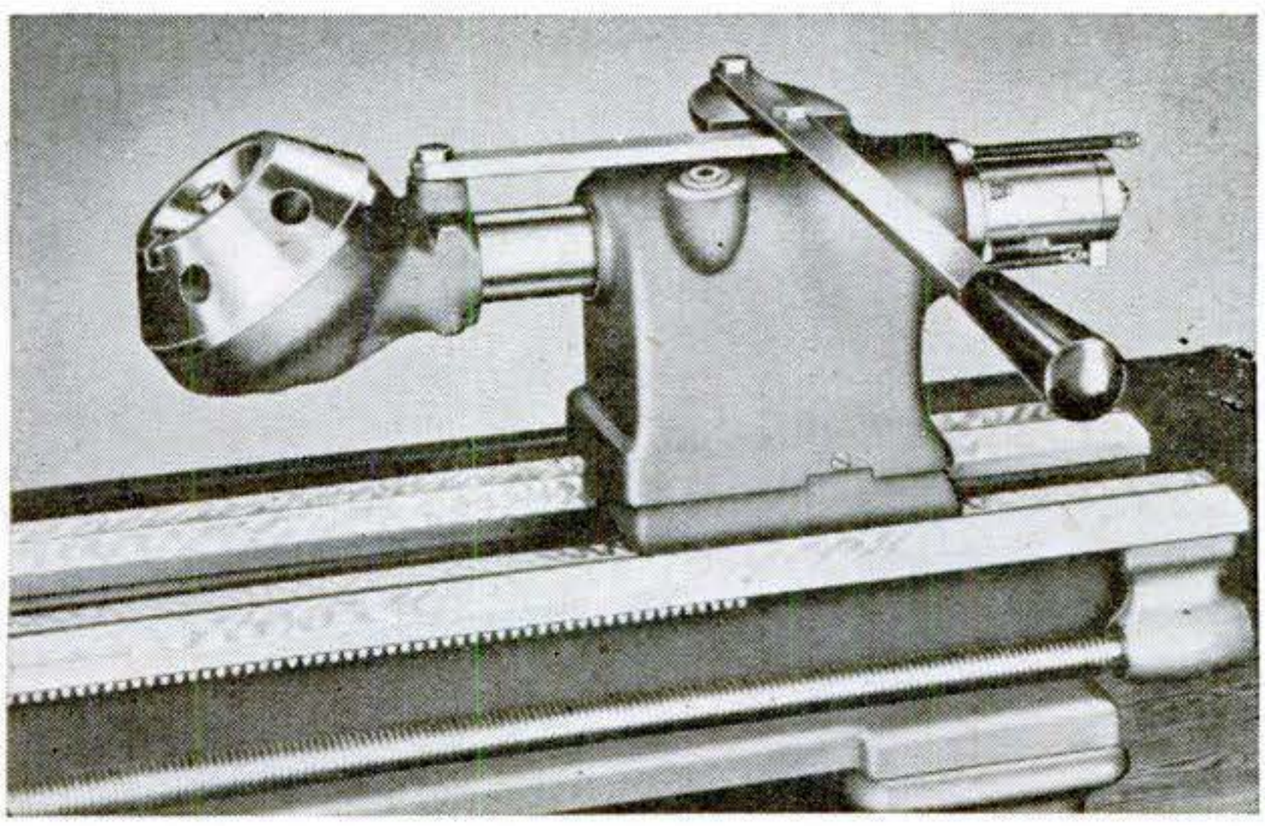
NEW TOOLS

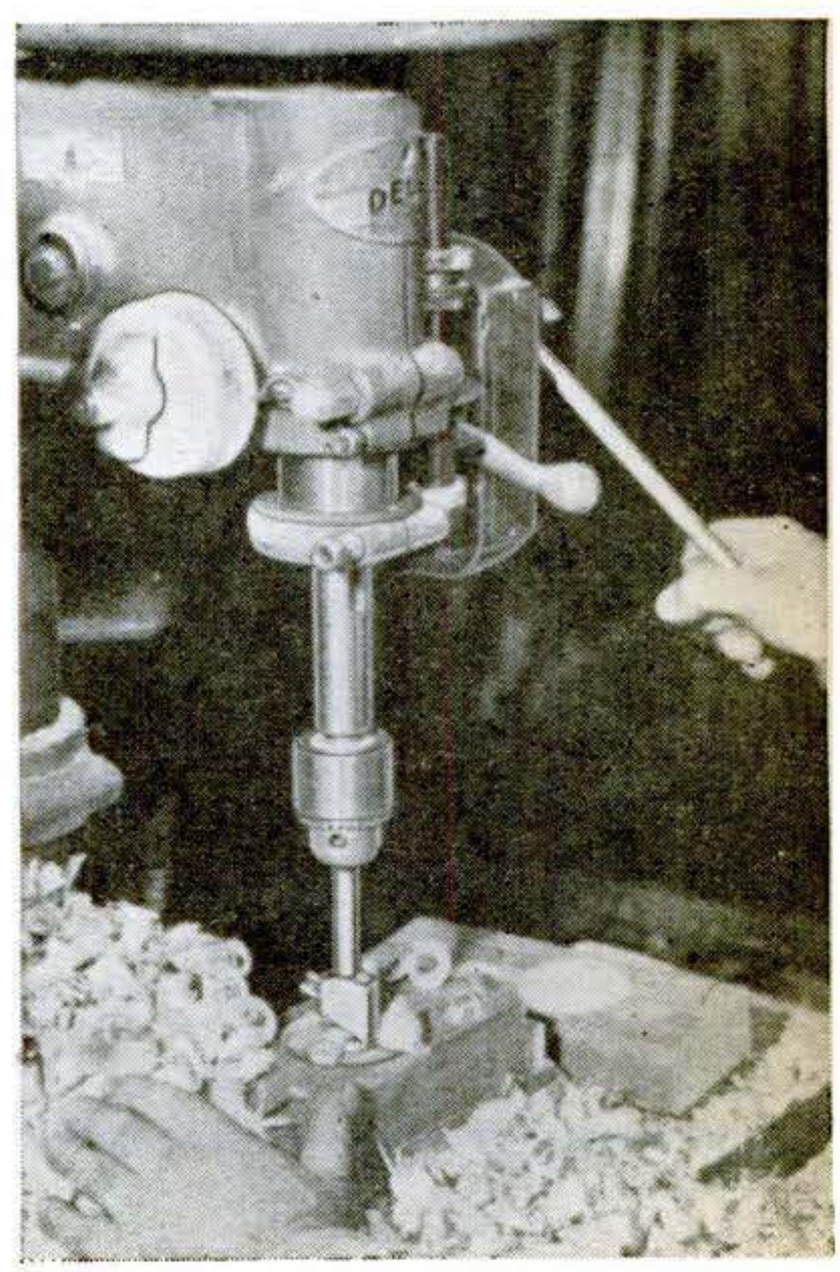


AIR VISE. For fast production work on drill presses, milling machines, grinders, and shapers, the Speedy Air Vise (above) is operated by a foot valve, leaving the operator's hands free for insertion and removal of the work. Its gripping force is 15 times shop air pressure. W. R. Brown Corporation, of Chicago, is the distributor of this device.

STENCILLING is simple with a T-shaped cast-aluminum brush made by the Marsh Stencil Machine Co., of Belleville, Ill. Ink from the handle reservoir is controlled by a valve button.



TAILSTOCK TURRET. With a six-station head and a hand-lever feed, this new turret attachment is manufactured by the South Bend Lathe Works for use on their 9″ models. The head accommodates tools having ⅝″ shanks and the slide has a stroke of 3¼″. At each station the depth of cut is regulated by a stop that indexes automatically as the turret head is rotated to select different tools.



HOLES IN WOOD from 1½″ to 3½″ in diameter are cut with this heavy-duty expansive bit made by Bruno Tools, Beverly Hills, Calif. A ½″ straight shank permits use in either drill press or electric drill. Unusually fine threads on the lead screw help make clean, true holes.

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Making Your Own Window Sash

By Edwin M. Love

SHORTAGES being the order of the day, the small builder must at present use procedures and materials that would be unconventional, at the least, in normal times.

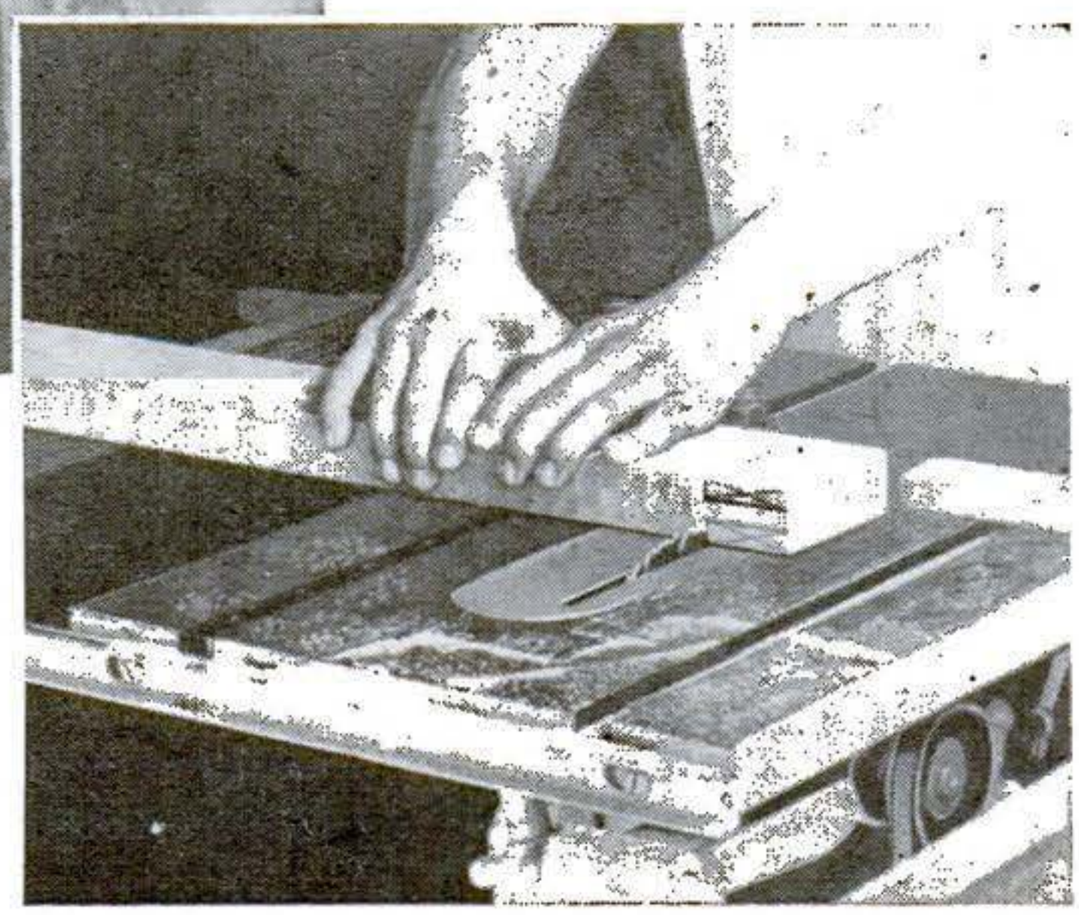
Thus the writer, confronted by a shortage of window sash, had a choice of submitting to indefinite delay or of constructing the sash himself. He found that making sash was not difficult and was in fact an interesting exercise in precise woodworking. A drill press and circular saw are necessary to reduce the job to manageable proportions; a shaper is convenient but hardly necessary. It can be dispensed with if a modern stepped molding is substituted for the traditional ogee.

Sash should be built of clear, seasoned stock. If this cannot be obtained, select the best available and cut it into oversize rough pieces. Stack them grid style and let them season for as long as possible. Lumber 2″ by 12″ in size cuts to advantage and is less expensive than some smaller sizes.

When dressing the pieces to finished size, check for wind and mark the name of the part on the face side. Cut rails to net length including tenons so the tenons can later be gauged simply by butting the ends against stop blocks clamped to the circular-saw table. Stiles may be rough or finished lengths.

How the upper sash of a double-hung window is constructed is shown in Fig. 1 on page 164, the lower sash in Fig. 2. Size is governed by the size of stock glass. Allowing ⅛″ for clearance, the width of the sashes should

Stock for window sash is cut oversize and allowed to season; then when ready for use, it is dressed down to finished size. Here a drill-press rotary planer reduces a piece to exact thickness.



Rails are first sawed to exact length, and tenon shoulders are then cut on the circular saw. Butt the ends against a gauge block clamped to the saw table to insure accurate tenon length.

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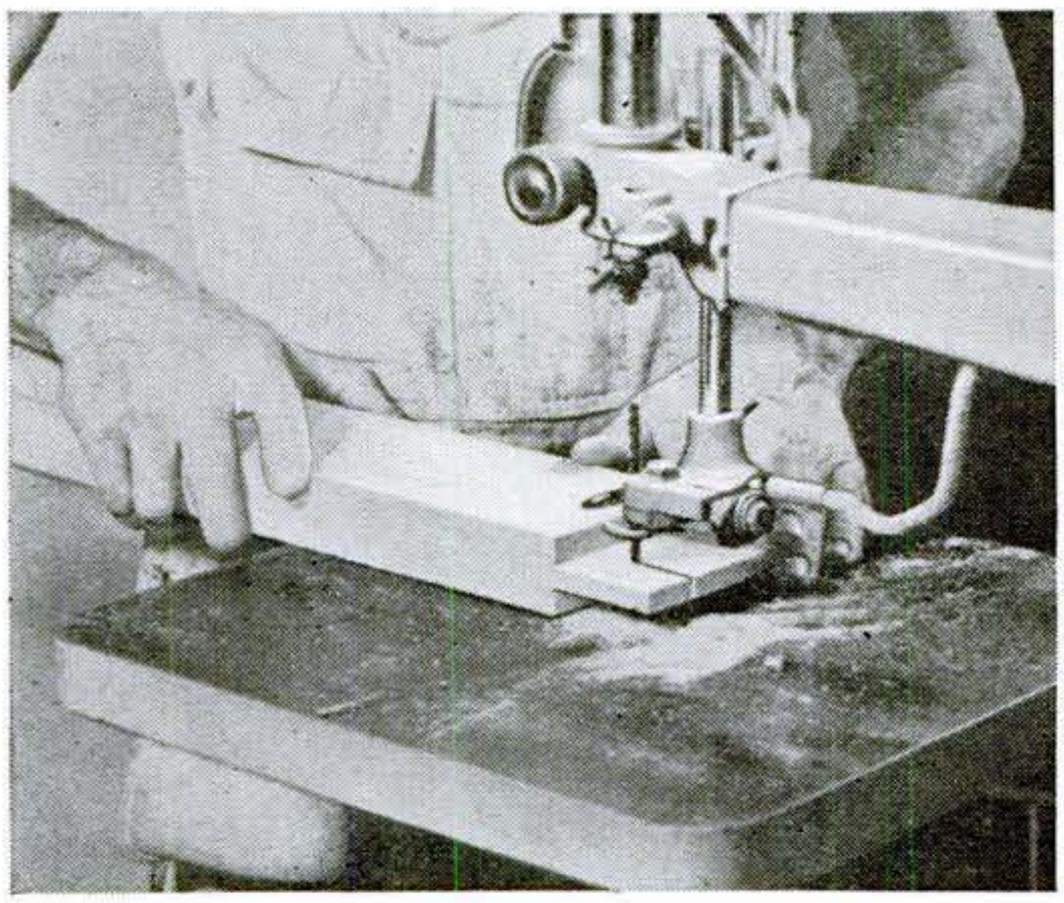
equal that of the glass plus 4⅛″, which includes the width of the two stiles minus two ¼″ glass rabbets. Thus, in the drawing, the dimensions between glass rabbets in the stiles is given as G^w + ⅛″.

The same allowance for glass clearance is made in the height of the upper sash, which should come to glass height plus 3⅛″ to which an extra 3¼″ for an ornamental underhang may be added if desired. In figuring the constant 3⅛″, upper-rail and check-rail widths, 2¼″ and 1¼″ respectively, are added, two ¼″ glass rabbets are deducted, and the glass clearance of ⅛″ is tacked on. Two dimensions between rails are given in Fig. 1. G^h − ⅜″ is measured between the lowest part of the upper rail and the top of the check rail; G^h − ⅛″ is measured from the rabbet in the upper rail to the top of the check rail.

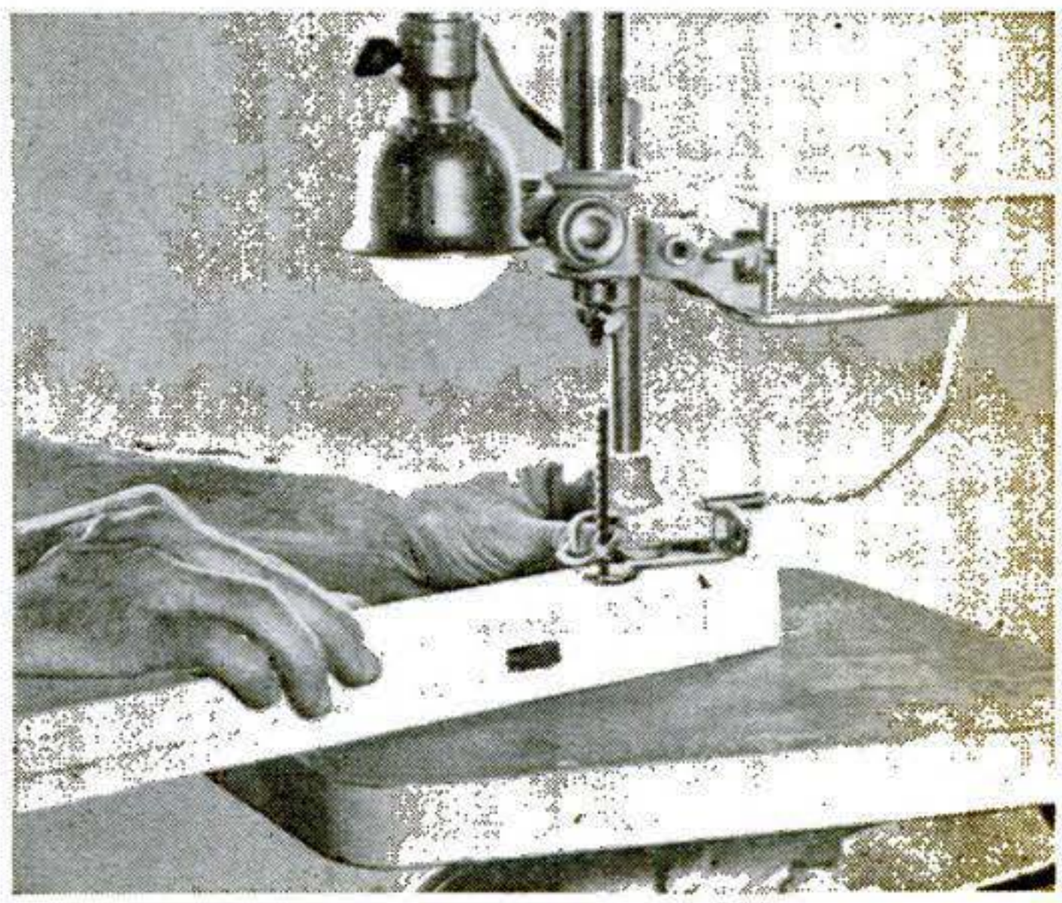
Since the lower rail of the lower sash is scribed to the sill when the windows are fitted, its width may well be 3½″. The formula for height of lower sash then will be glass height plus 4⅜″, allowing for a ¼″ rabbet, ¼″ kerf, and ⅛″ clearance.

Lay out the mortises and tenons carefully, marking the waste wood with penciled crosses. Some experienced workmen dispense with this, but there is always danger of making mistakes when the markings are omitted.

Clamp a gauge block on the circular-saw table and cut tenon shoulders to a

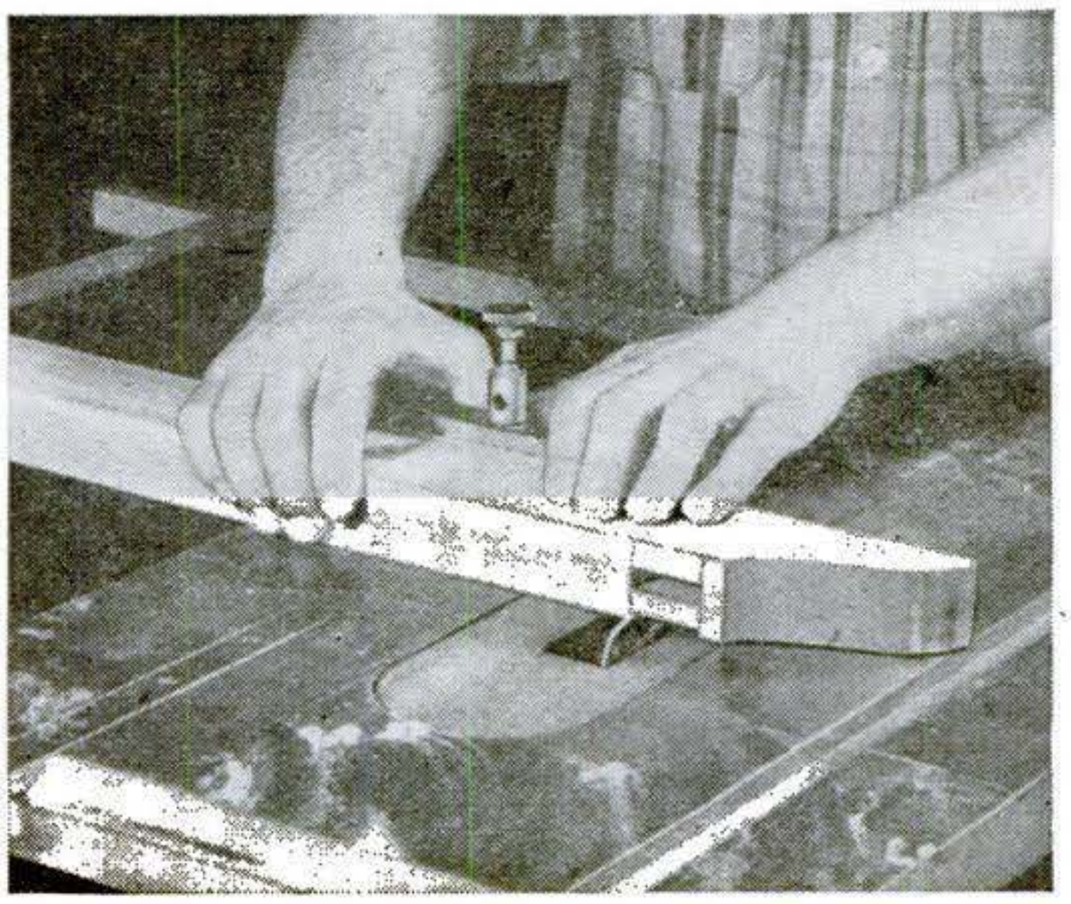


After the cheeks have been cut to thickness, the width of the rail tenons can be ripped. This is conveniently done on a bandsaw or jigsaw.

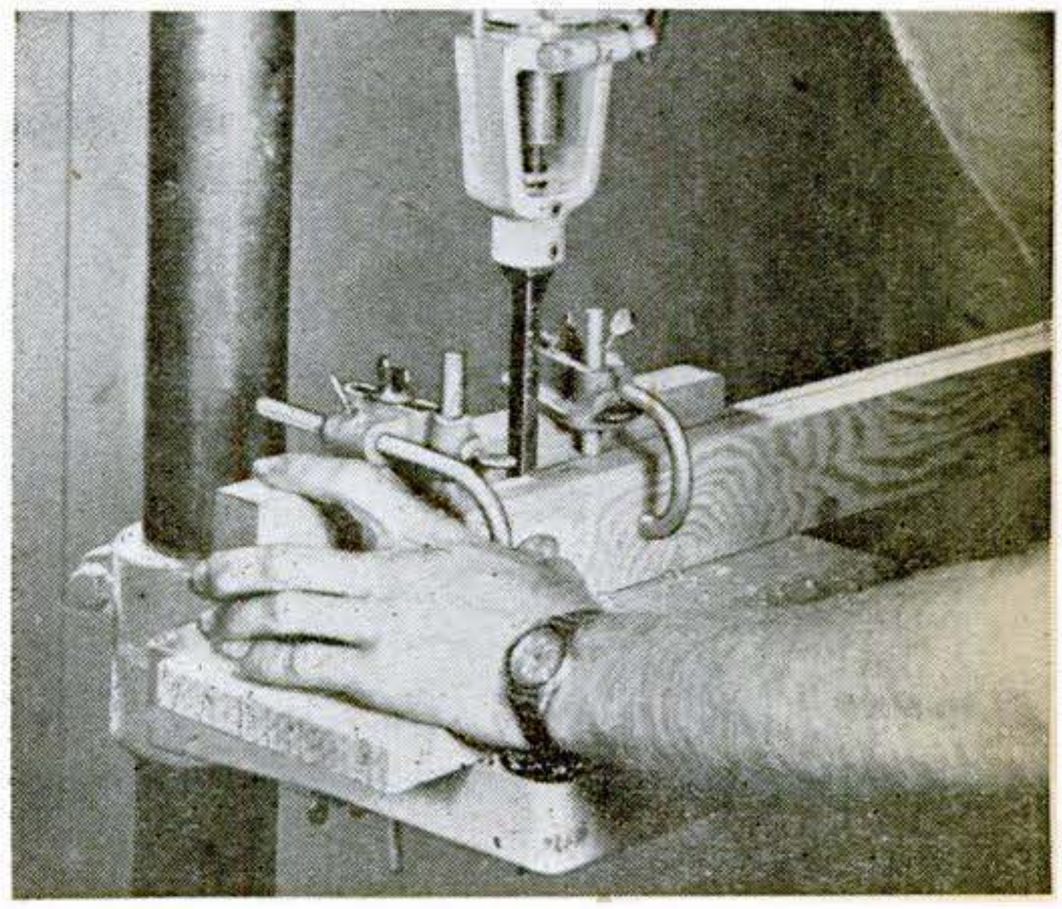


For an ornamental finish on upper sash, lay out a curve from a paper pattern on the extended lower end of the stiles and cut on the jigsaw.

One face of the stiles must be dadoed to receive the outer tenon of the double-tenoned check rail. Fit the other tenon in the stile mortise.



When mortising on the drill press, clamp a block under the fence and stile to prevent splintering at the edges when the bit comes through.



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depth of ⅞", leaving the corners to be cleaned by the ripping cuts. The face edge can be held against the miter gauge for all cuts if the gauge is turned end for end in the slot for cutting opposite faces. Shoulder the check rails on one side only.

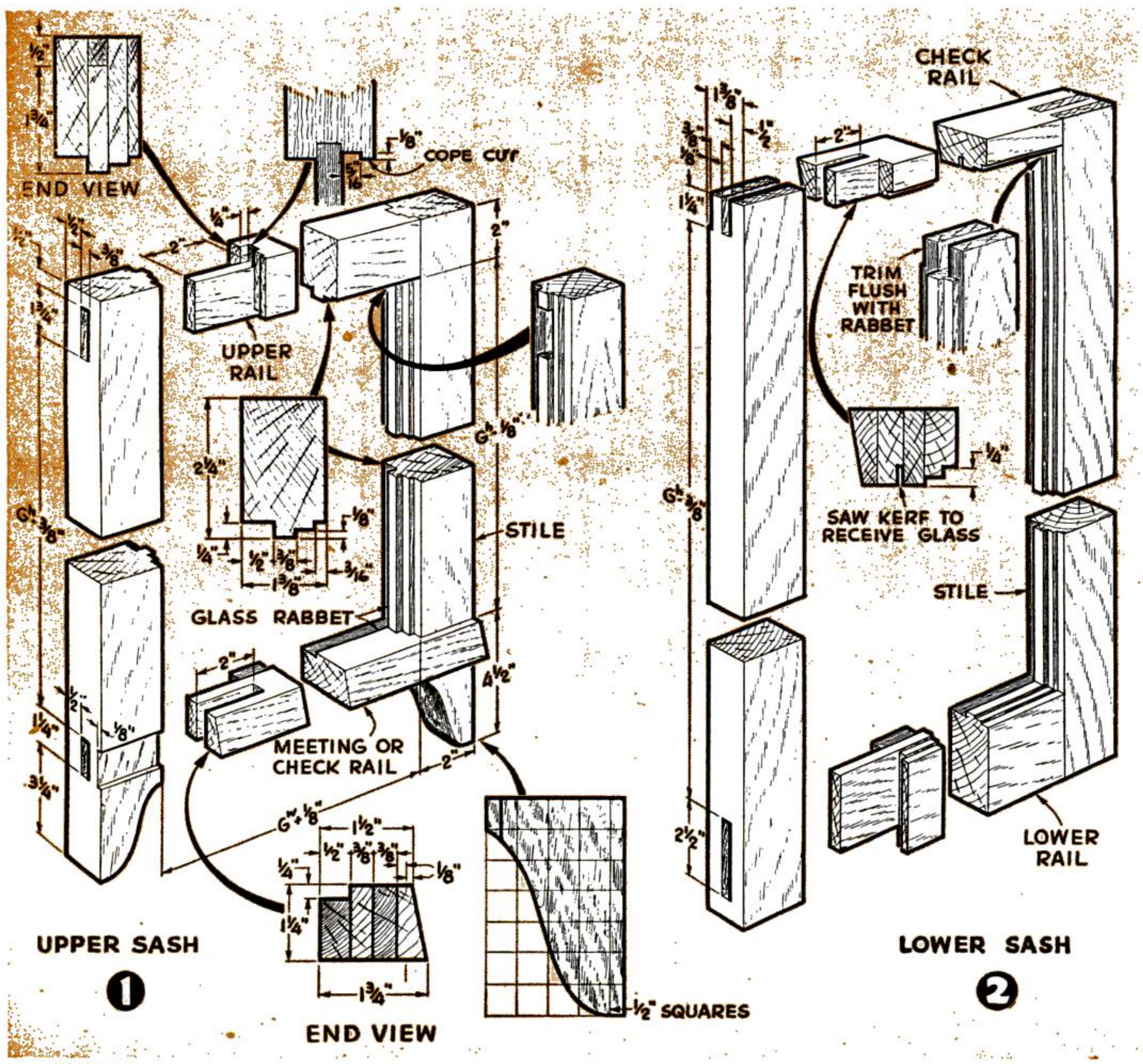
A method of ripping the tenon cheeks is shown in Fig. 3. Support the face side of the rail against a high auxiliary fence and rip the cheek on each end; then shift the fence and cut the opposite cheeks. All cheeks on the same side can be cut at one setting and the fence then shifted for all second cheeks. If two blades are available, set them up with a ⅜" spacer between and cut both cheeks of a tenon at once. Rip to width on a bandsaw or jigsaw.

Set up the drill press for ⅜" mortises, clamping a block under the fence to prevent splintering as the bit comes through. If stiles are cut to finished length, the ends of the mortises can be located by stop blocks clamped to an auxiliary fence long enough to accommodate the pieces. All upper mortises are cut first, and the stop blocks then changed for the lower mortises.

Before shifting the fence, mortise the rail ends to receive the stile tongues, cutting in from the upper edge of the top rails and the lower edge of the bottom rails, as in Fig. 4. A gauge block screwed to the fence to make contact with a shoulder insures accuracy of these cope cuts.

Gain out the faces of stiles with a dado saw to admit the check-rail outer tenons and dado the inner edges for a fit against the rail shoulders. Molding and glass rabbets are next made on a jointer. Note that the check rails of the lower sash are kerfed to receive the glass (Figs. 2 and 5) and those of the upper sash are rabbeted.

Now, shift the drill-press fence and cut the notched mortises in the check rails, completing the double tenon. Finish coping



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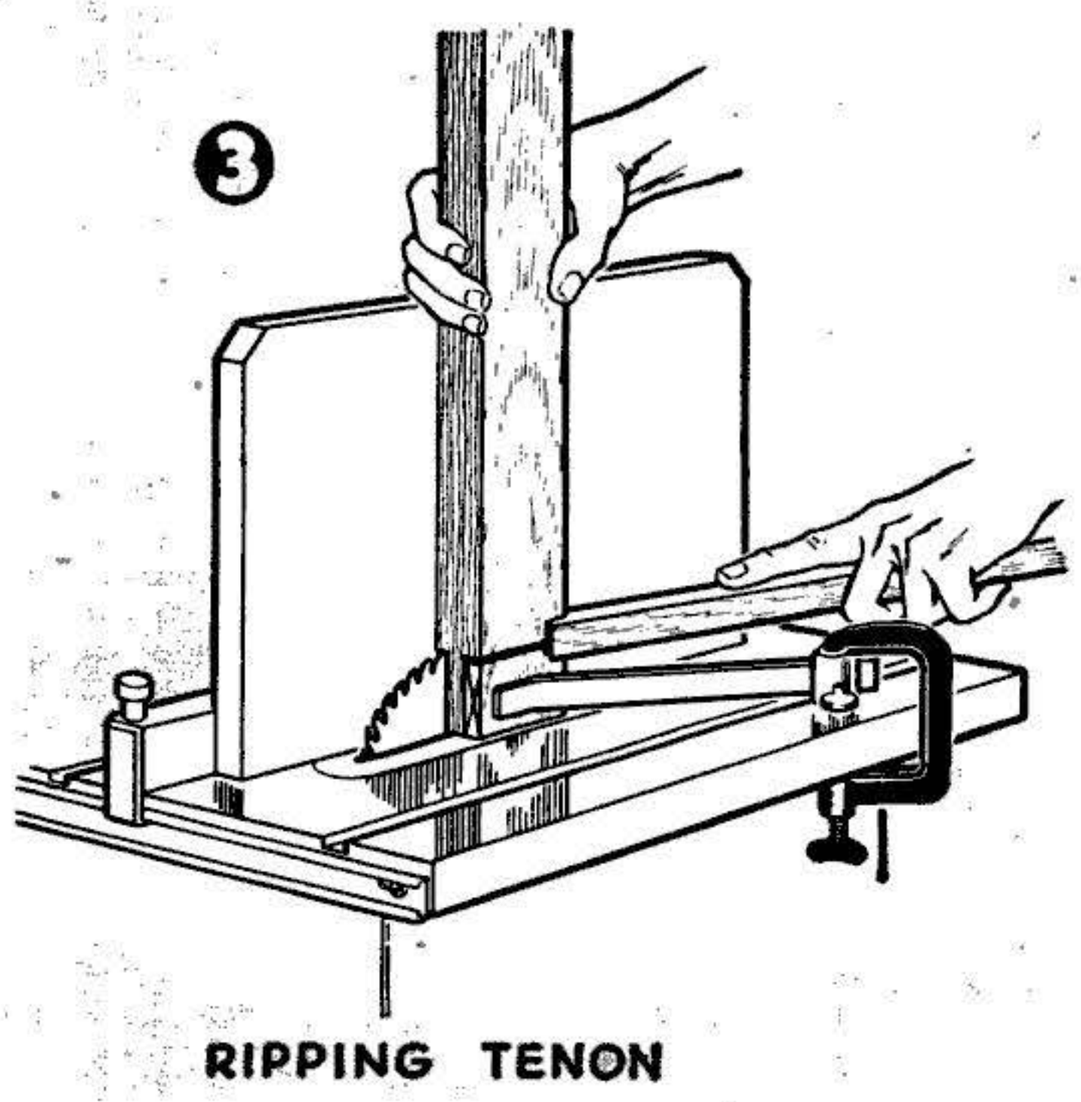
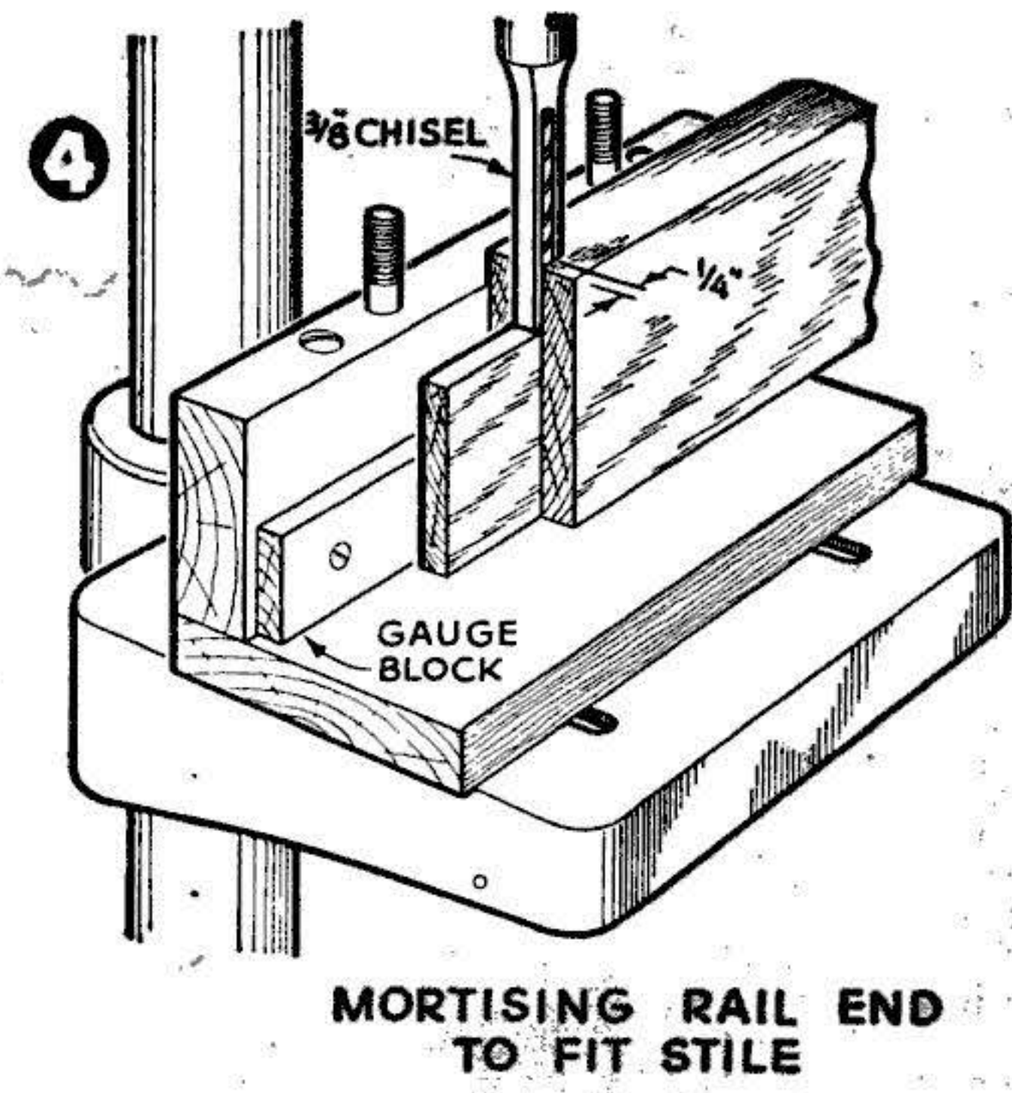


RIPPING TENON



MORTISING RAIL END TO FIT STILE

the upper end and lower rails with a 5/16" mortising chisel, cutting from both ends.

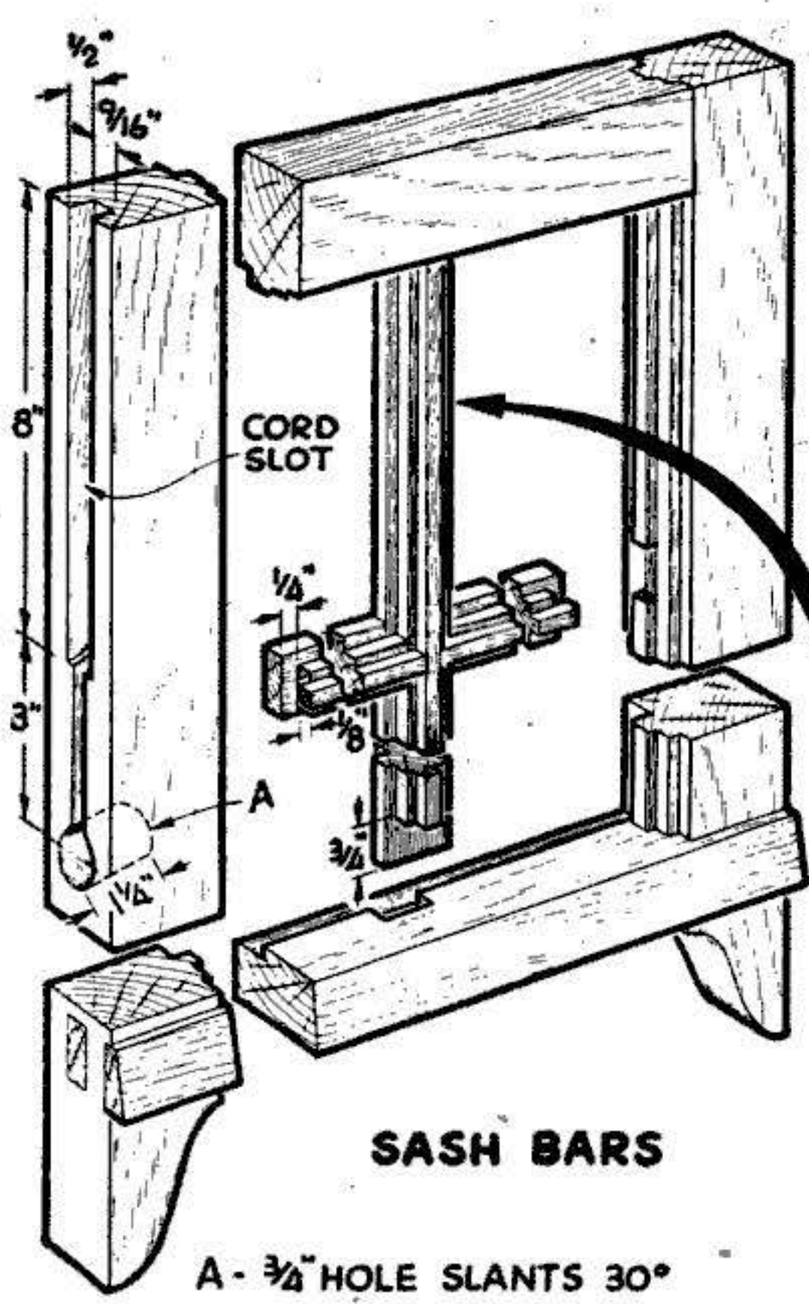
Make trial assemblies to check fits and glue with waterproof glue. Clamps can be removed immediately if one or two 4d. finishing nails are driven in to lock the joints. Sand the sashes and sand off the corners of the moldings. Prime the rabbets with linseed oil or thin paint to keep the wood from sucking oil out of the putty.

Spread a thin cushioning layer of soft putty in the rabbets. Lay the pane concave side up and press gently into the putty. Hammer three or four glazier's points in at top, bottom, and sides, using a flat chisel with the bevel on the glass. Roll putty thin between the palms, lay end to end, and smooth into the rabbets with a putty knife, beveling uniformly and avoiding extensions beyond the rabbet that would show from the inside. Trim off excess putty.

When windows are cut up into small lights, the over-all width equals the sum of the glass widths plus 1/8" clearance for each pane, 4" for stiles, and also plus the space occupied by the central thickness of the sash bars or muntins (T in Fig. 6). This thickness in the bars varies, being 3/16" for six to 12 lights, 1/4" for three to four lights, and 3/8" for two to four lights in large windows.

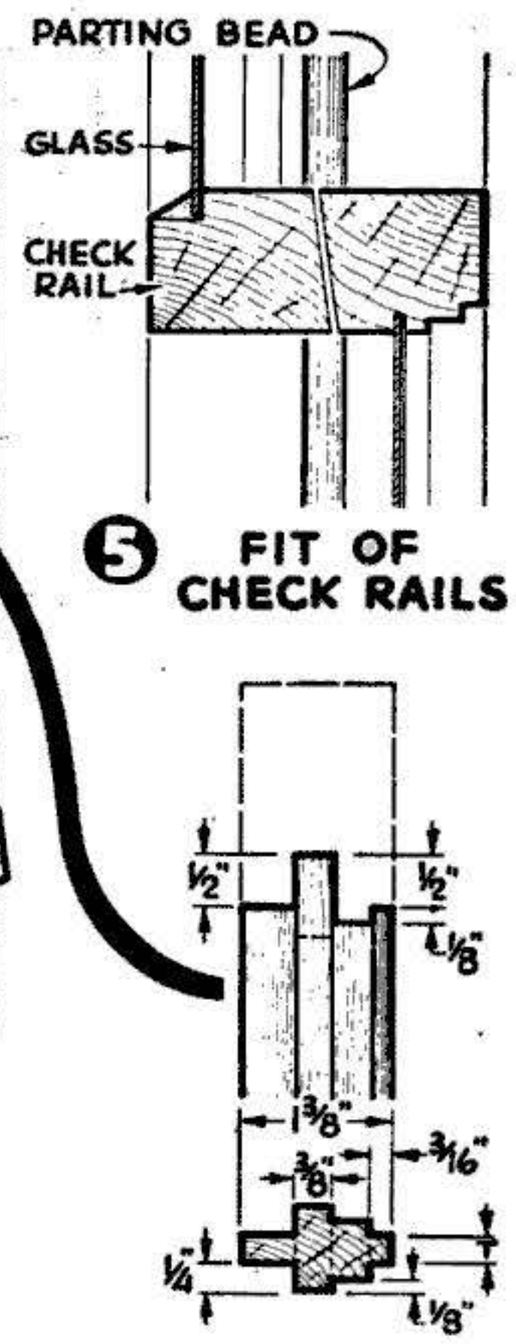
Vertical bars are mortised 3/4" into rails and horizontal bars, the others 1/4" into stiles and vertical bars. To tenon the ends, cut the stock to length, using the dado saw for cope cuts. Then rabbet to match the frame.

When sash is to be hung with spring balances, nothing need be done with the outer edges until final fitting. For sash weights, make cord-knot holes and cord grooves.



SASH BARS

A - 3/4" HOLE SLANTS 30°



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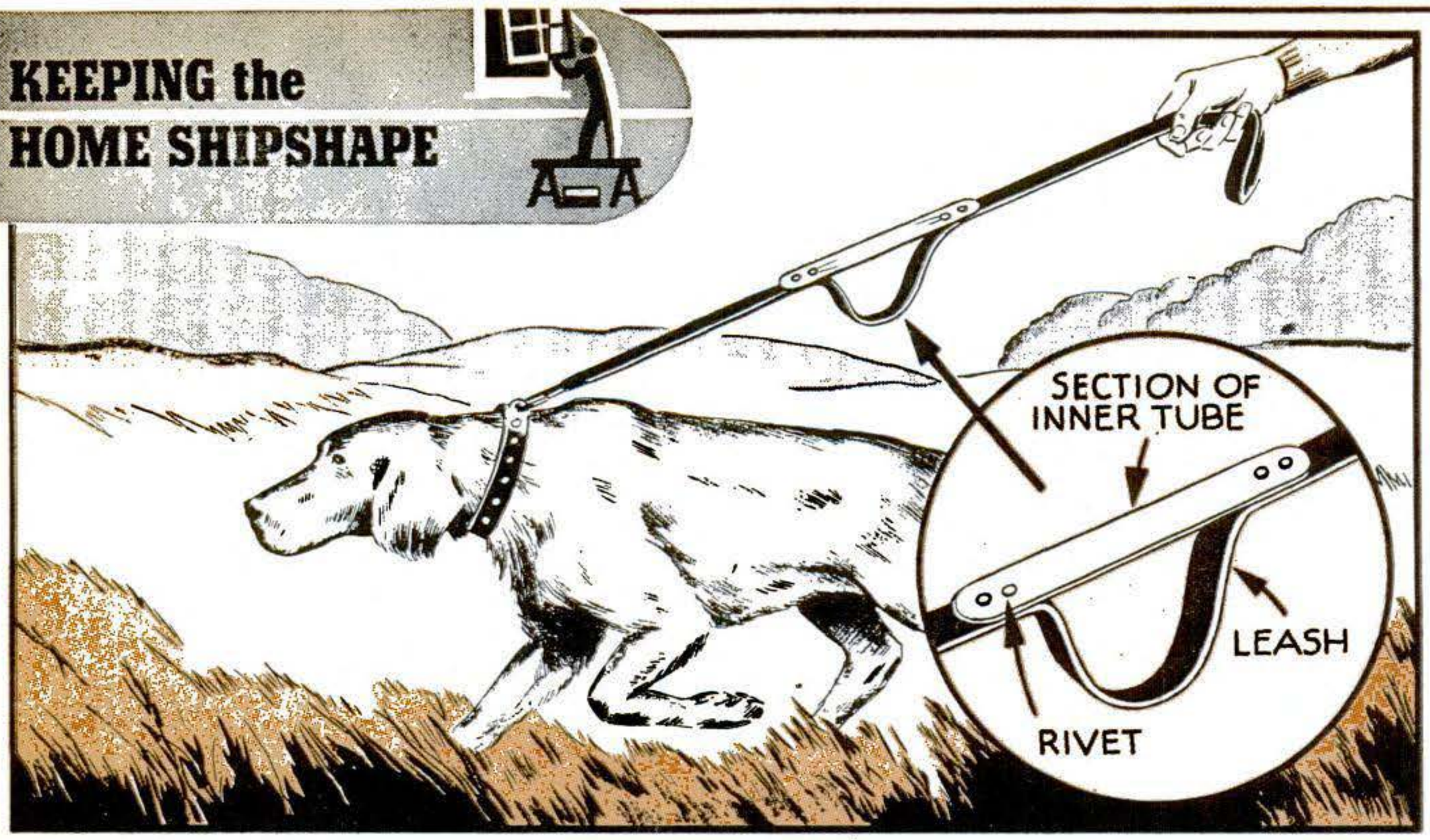
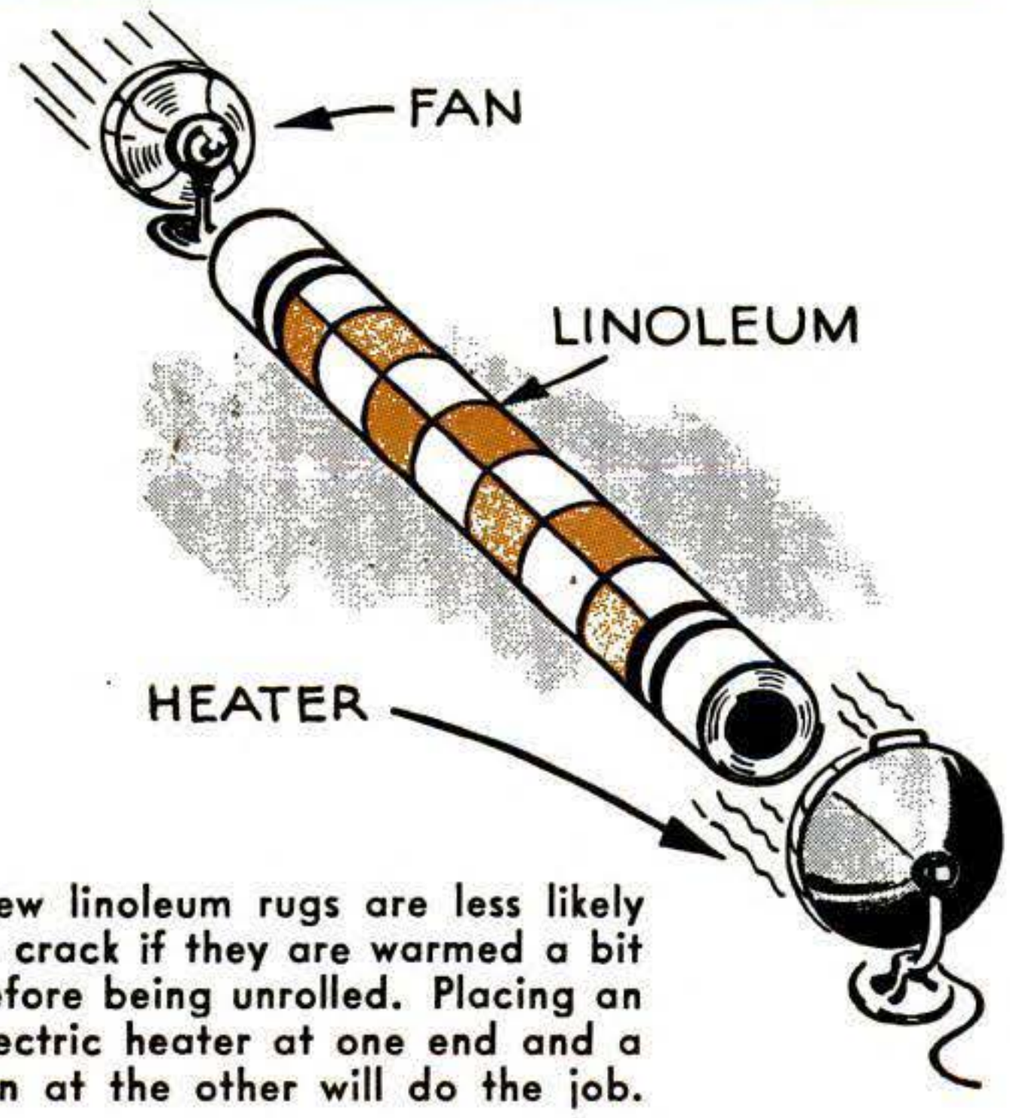
KEEPING the HOME SHIPSHAPE



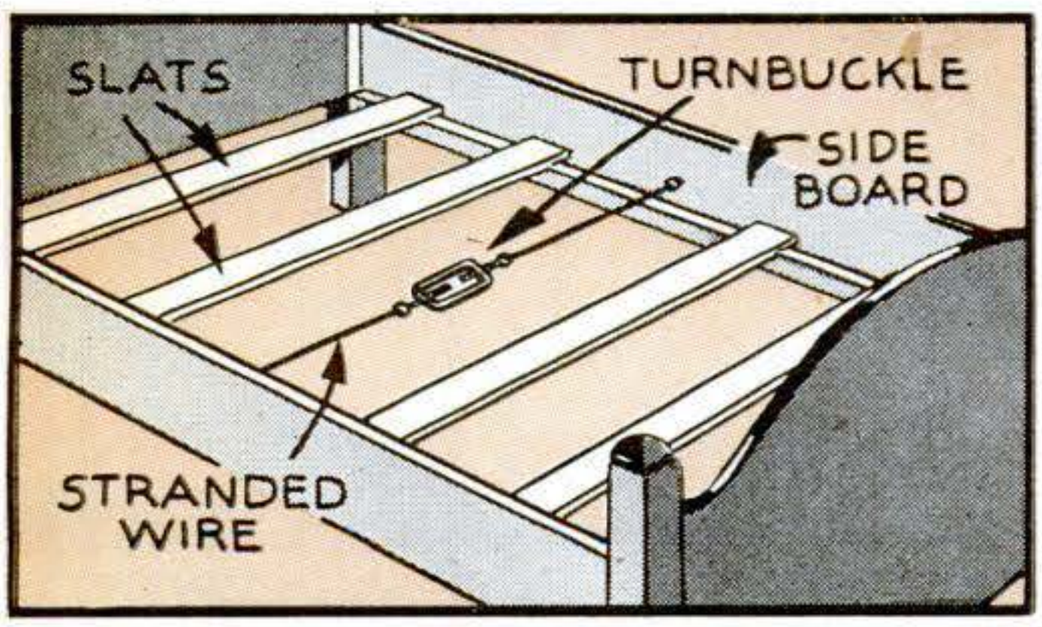
If your dog often lunges and jerks on his leash, try riveting a strip from an inner tube so that it bridges a loop in the strap. This keeps the dog's normal movements under control yet transfers very hard pulls to the greater strength of the leather.

Regular-size garden trowels may be too large for use in small pots, but both in size and shape an ordinary shoehorn makes a very convenient trowel for repotting small plants, as illustrated below.

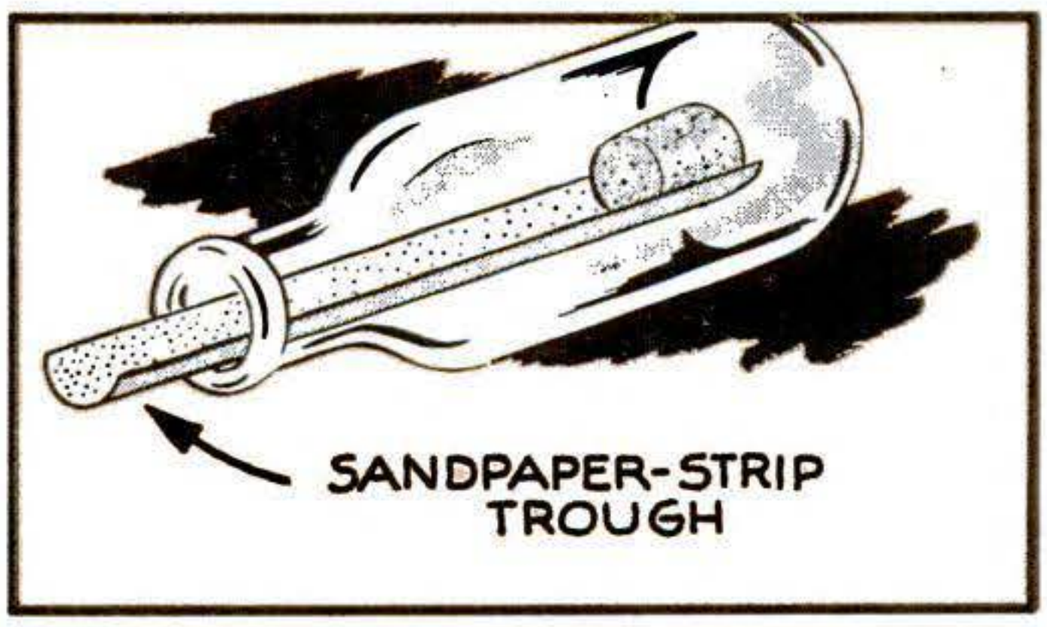


New linoleum rugs are less likely to crack if they are warmed a bit before being unrolled. Placing an electric heater at one end and a fan at the other will do the job.

When sideboards on the type of bed pictured below warp and permit the mattress-supporting slats to fall out, fasten wire from the boards to a central turnbuckle and tighten until the sides are secure.



A strip of coarse sandpaper, shaped into a trough, will help to remove a cork that has fallen into a bottle. Friction against the rough paper holds the cork while it is pulled through the bottle's neck.



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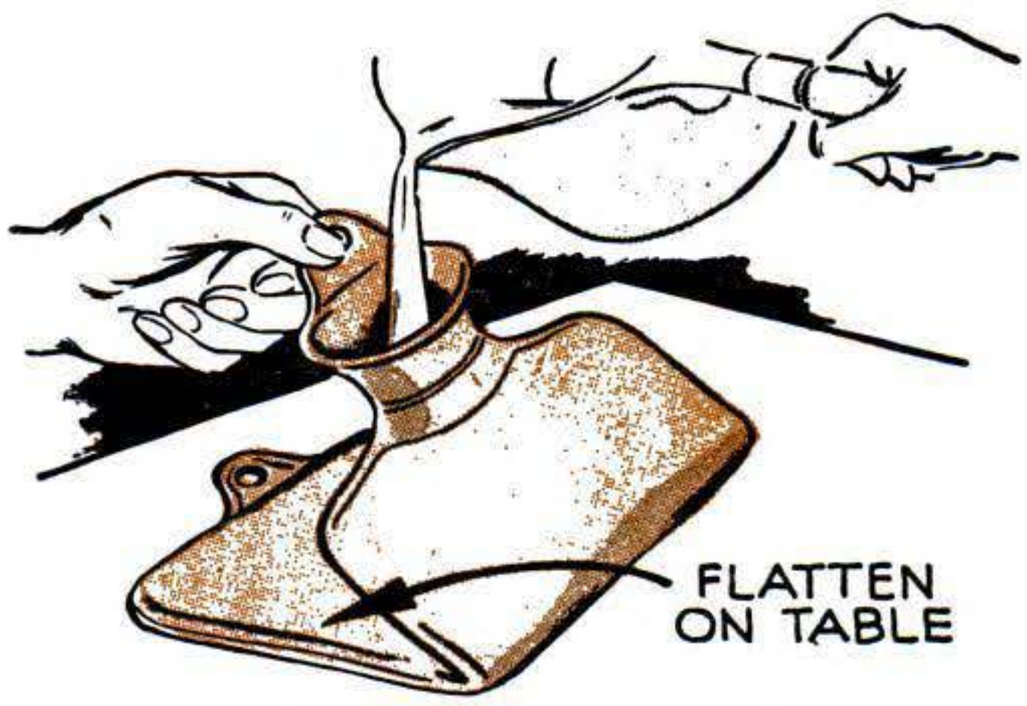
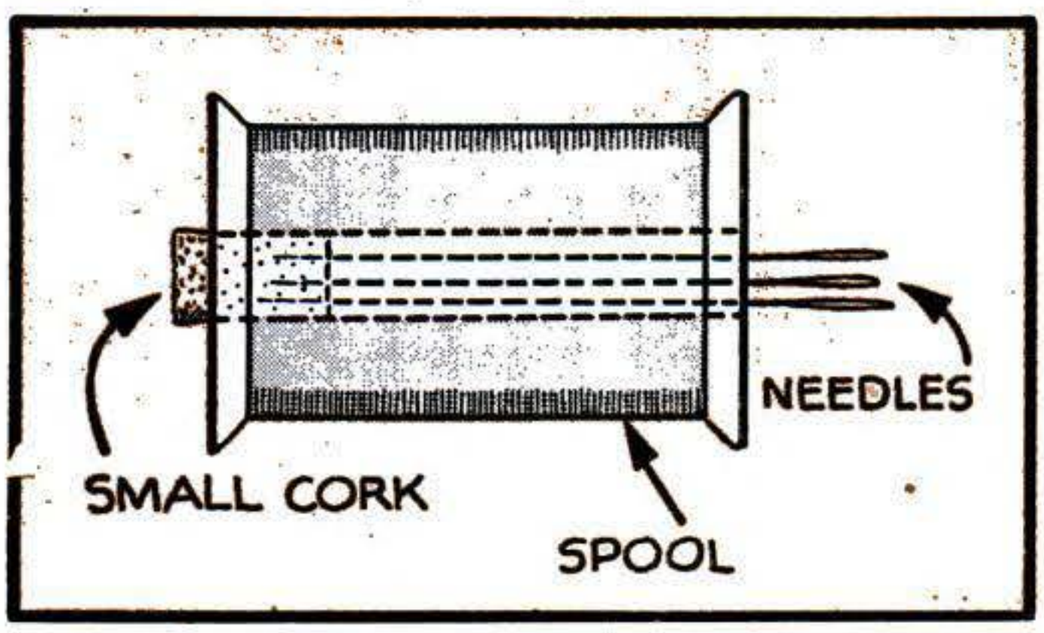
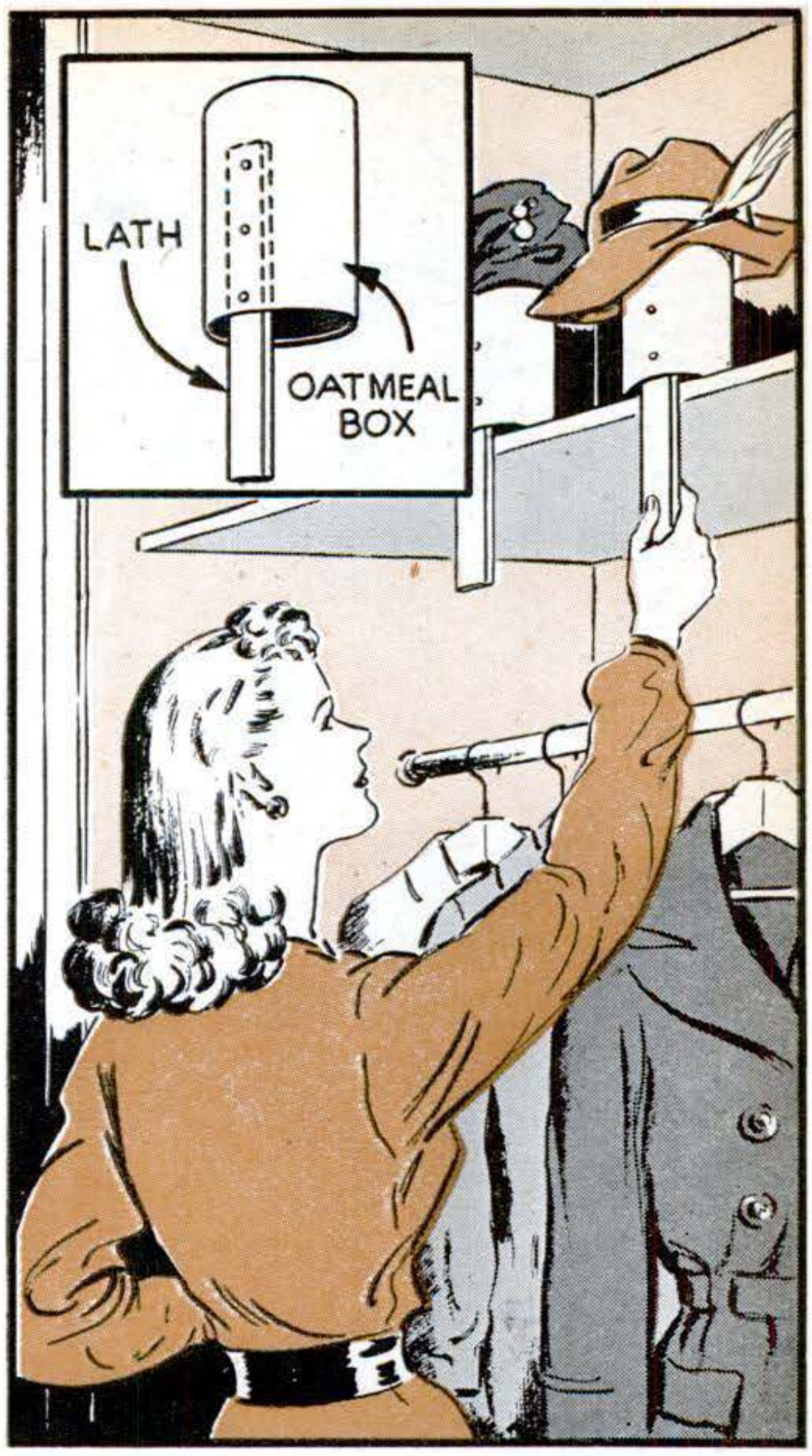
White and colored damp clothes can be carried in one basket when separated by plywood partitions. Two types are suggested above. Wax both sides to keep dirt out of the wood and make cleaning easy.



To prevent scalding water from bubbling over your hand when filling a hot-water bottle, flatten the bottle to expel the air, then hold it creased, as shown above, while pouring in the boiling liquid.

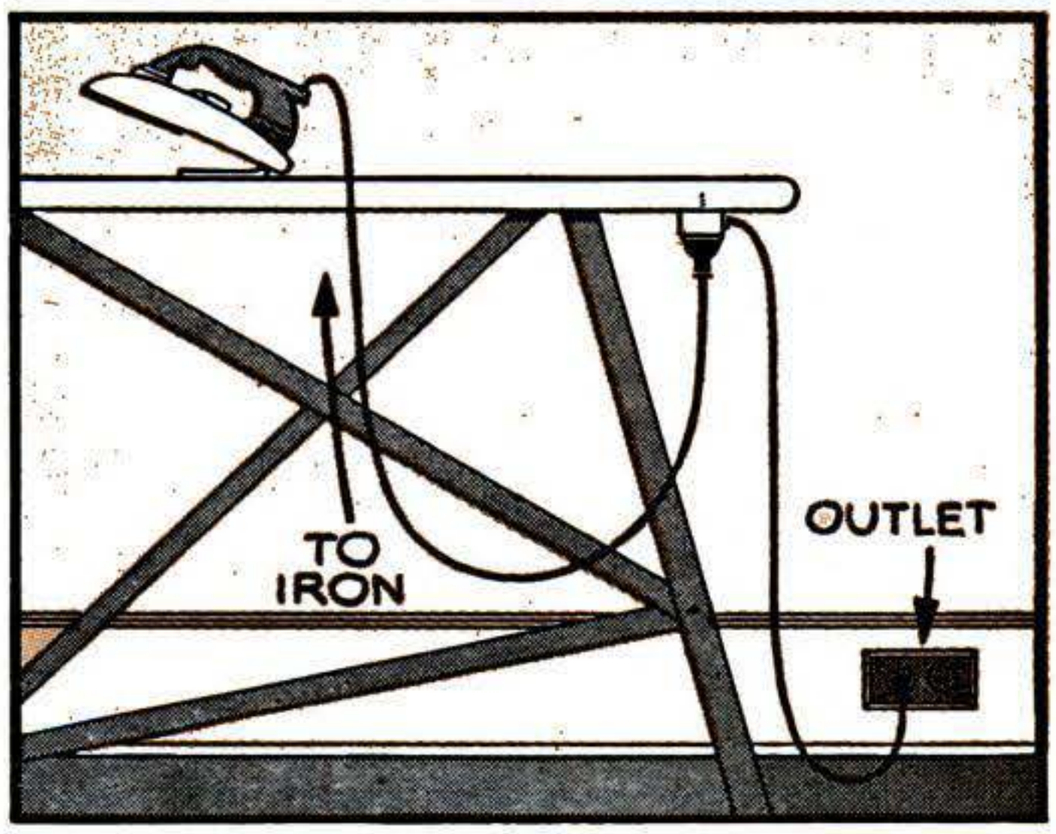
Sticking needles through spooled thread after use often damages or breaks the fibers, but a cork in one end of the spool holds the sharp points without risk either to your fingers or to the thread.





A closet shelf is a convenient place to keep your hats, but it often seems as though the shelf were built for the exclusive use of giants. Wood strips tacked to the inside of oatmeal boxes, however, make it easy to lift hats off or onto the shelf.

You can extend the length of your iron cord without adding the weight of an ordinary extension by attaching an outlet under one end of the ironing board. Connect a length of heavy-duty wire between it and a plug going to the baseboard outlet.



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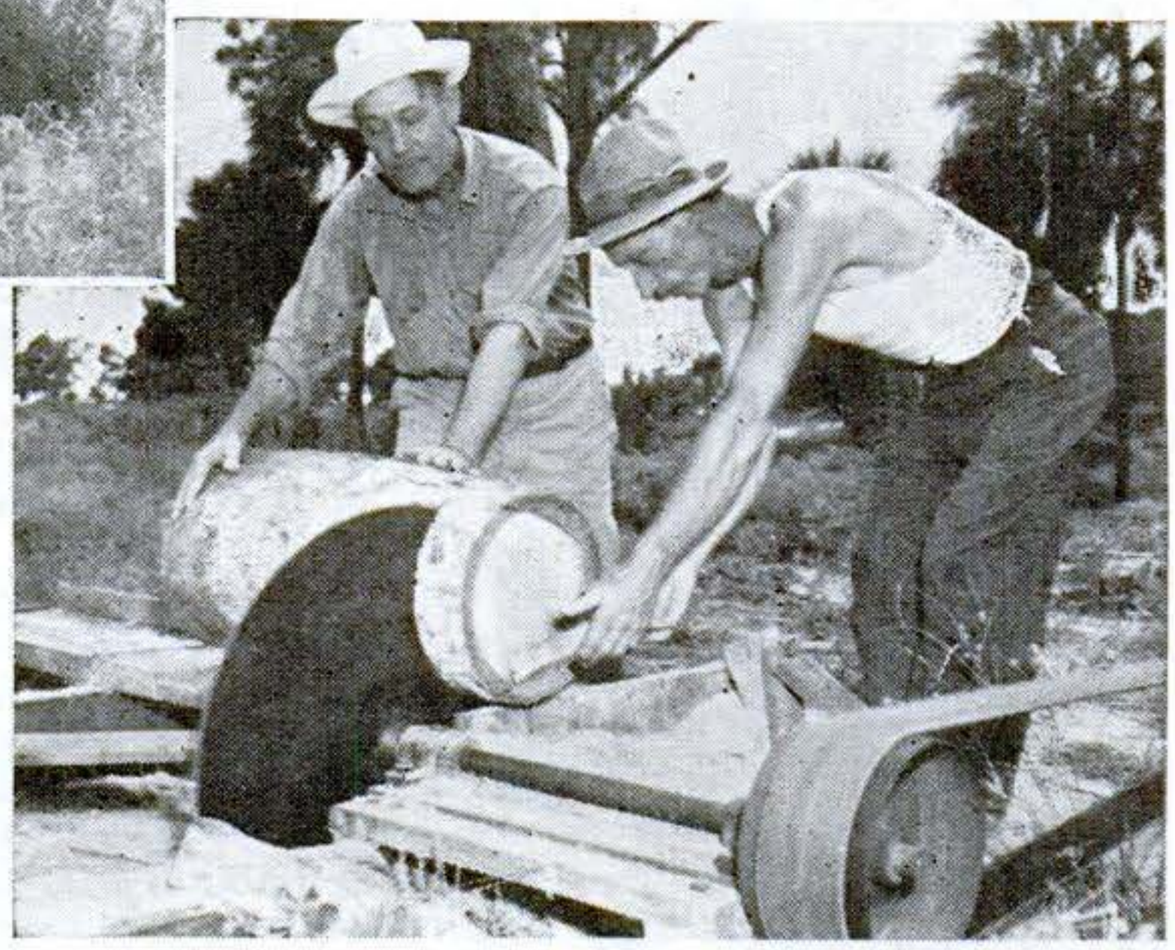
FOUR WALLS FROM PALM TREES

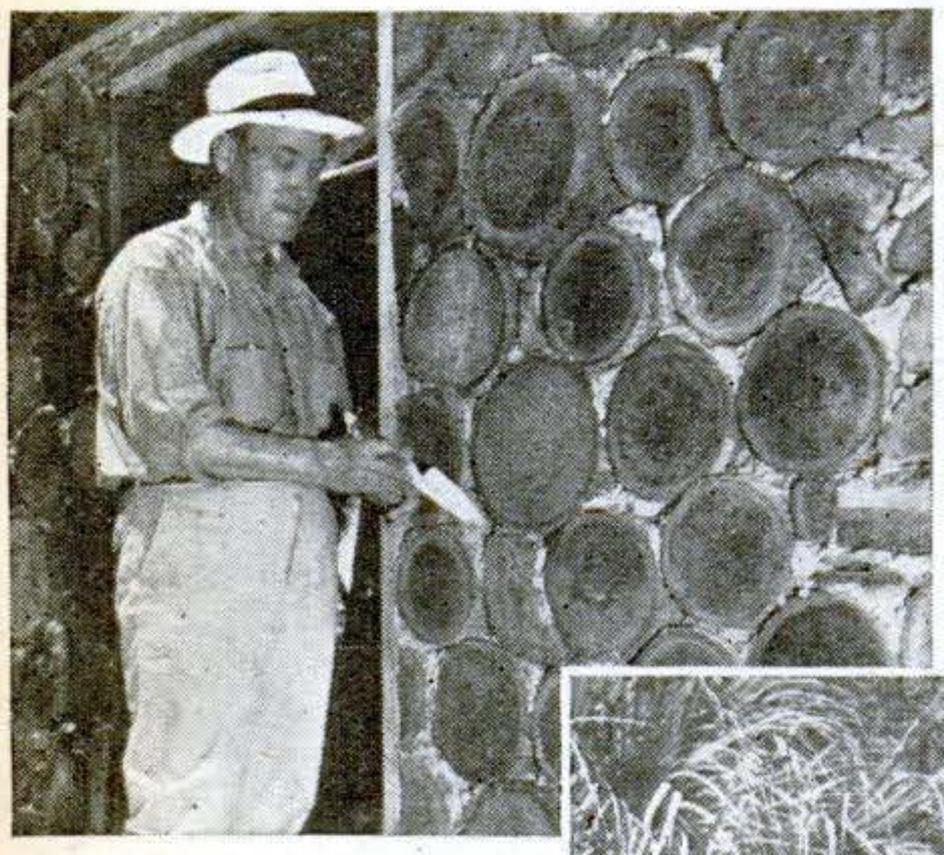
There will be fewer palm trees on the Florida scene—but more houses. Cut into sections, the palms are being used for bungalow walls.

LUMBER shortages don't stop C. L. Baker, Florida builder. He is constructing bungalows from palm trees, making the walls of 7″ sections of the tropical logs laid face out and covered on both sides with concrete. The result, he claims, is a structure too tough for termites, fire resistant, and soundproof.

The house shown, one of a group of four intended for tourists, contains two apartments, each with living room, bedroom, bath, and kitchenette. A bungalow requires only $28 worth of the plentiful palm logs, and could be built, Baker believes, in 30 days if a fast method of sawing up the trunks were devised. At present, work is slowed by the unusual toughness of the palm wood. Cutting the 7″ sections requires considerable time.



Baker's biggest problem in using palm logs is sawing sections. The diameter of this blade was reduced 3″ in cutting the tough fibers of trees for one house.



Above, the builder shows palm-section wall before it is finished with coat of concrete. Inside walls will receive the same treatment. At the right is the two-unit bungalow when nearly completed.

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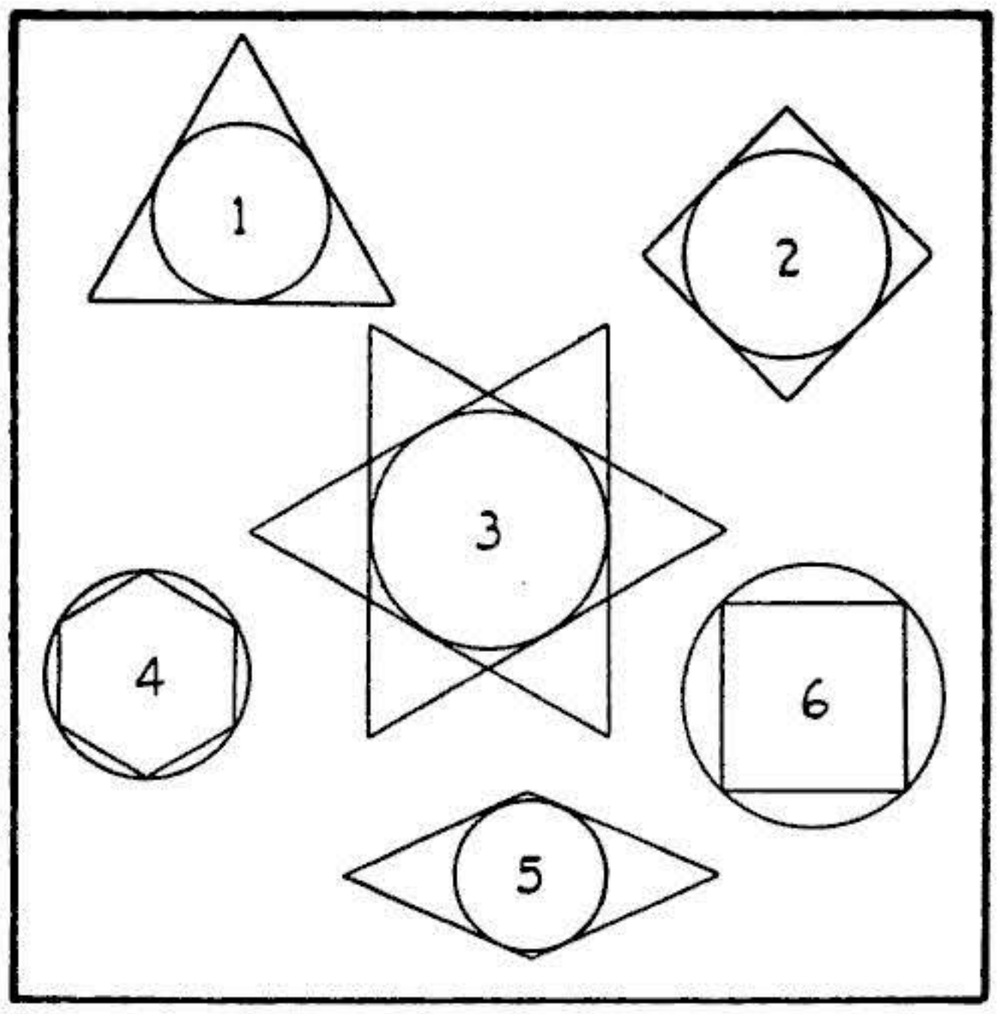
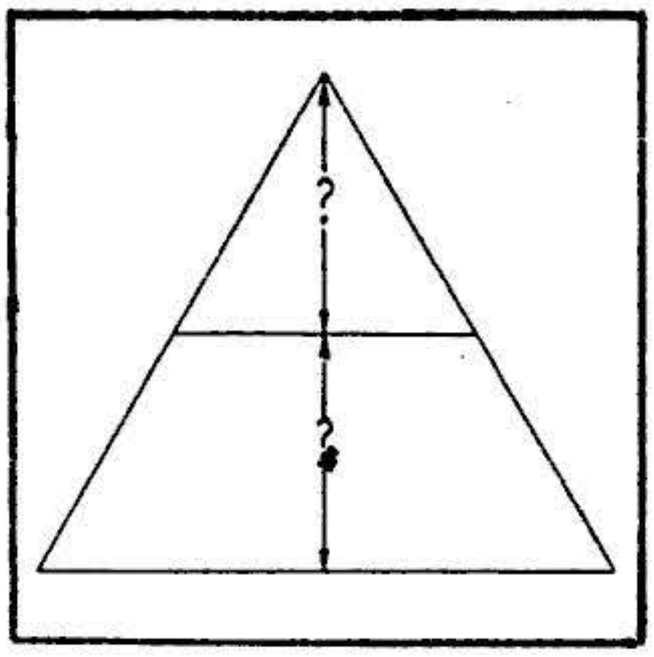
Can You Tell by Eye ?

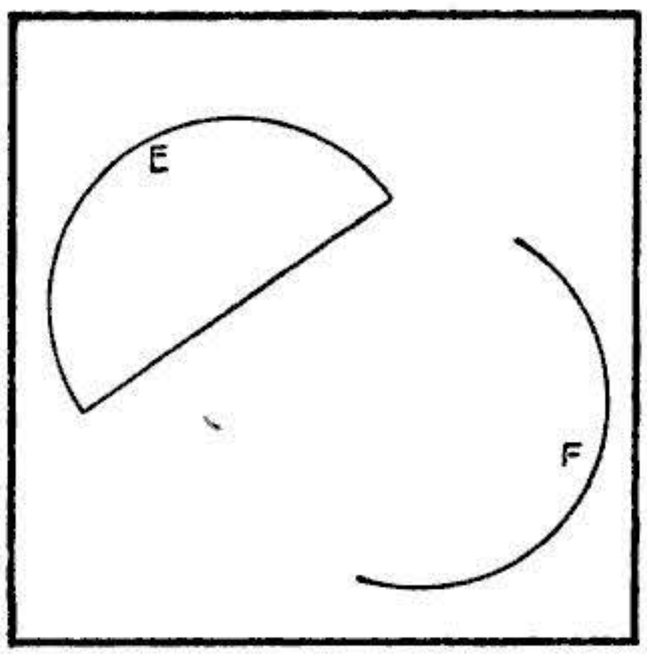
ARE you one of those people who can tell at a glance whether a chair will fit in a given space? Or do you need a rule for every measuring job? Whichever classification you claim, this optical judgment quiz will prove just how good you really are—or are you?



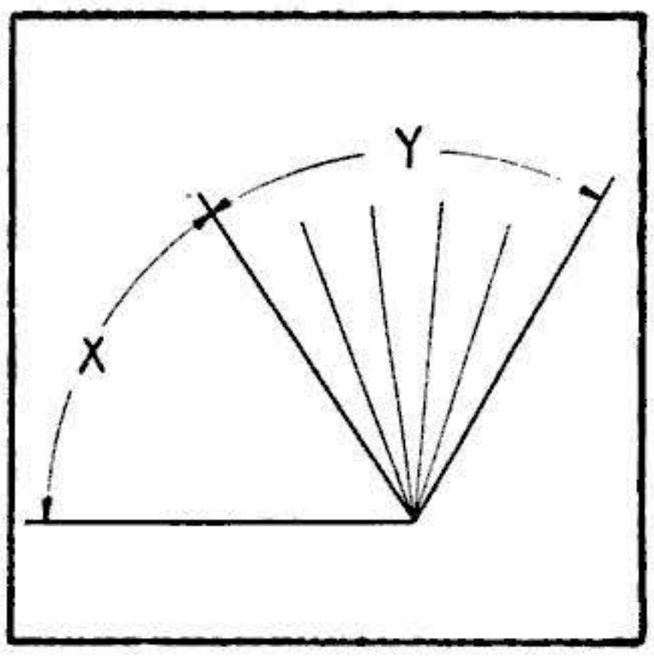
1. Each of the figures in the diagram contains a circle. Which two circles are the same size?



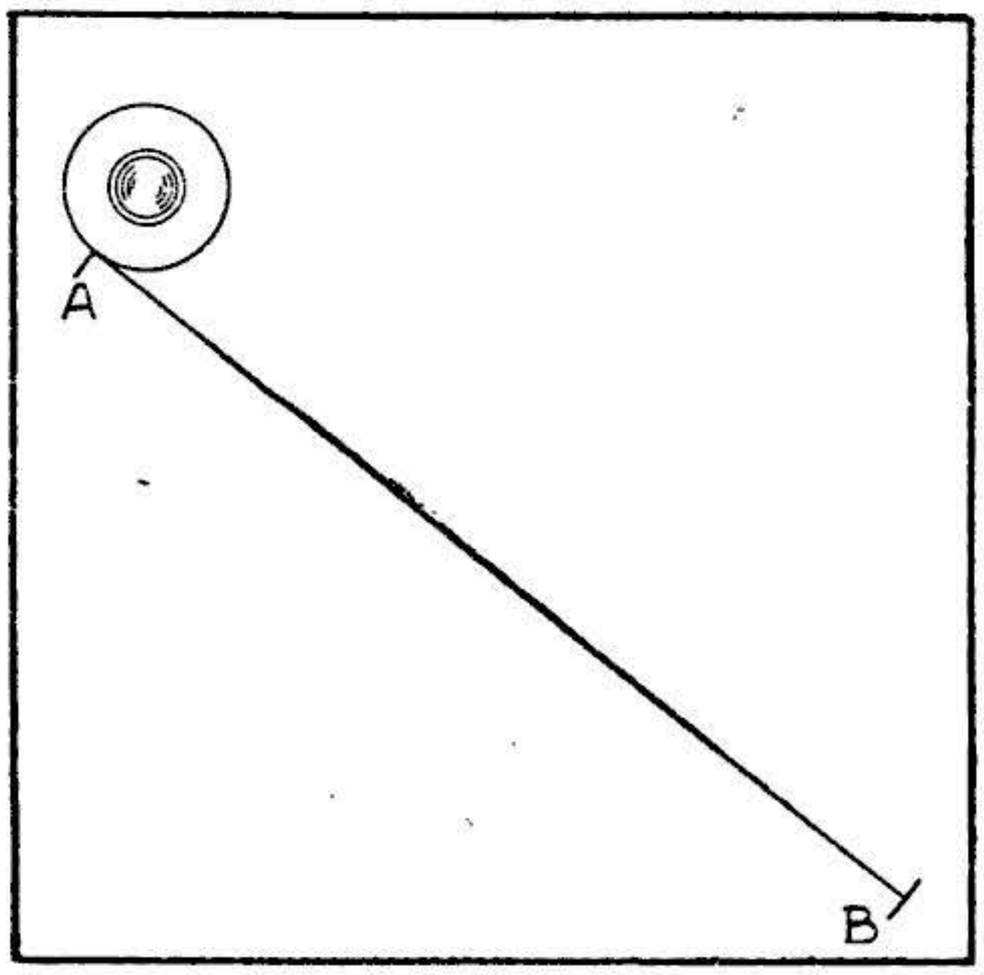
2. Is the top or bottom larger?



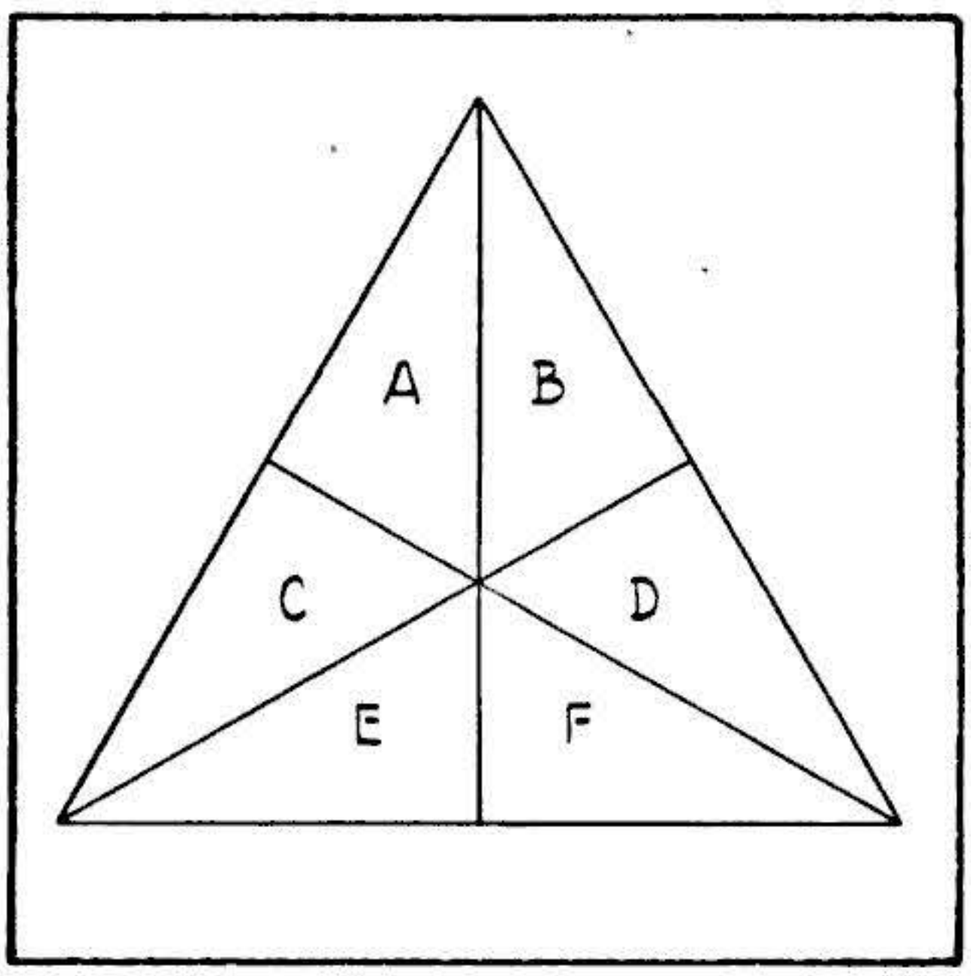
3. Which is longer, E or F?



4. Is X or Y the greater angle?



5. A to B equals how many turns of the wheel?



6. Are all the small triangles the same size?

Answers: 1. Nos. 2 and 4 are the same. 2. Top portion is larger. 3. E is longer. 4. Y is greater. 5. Two turns. 6. All triangles are same size.

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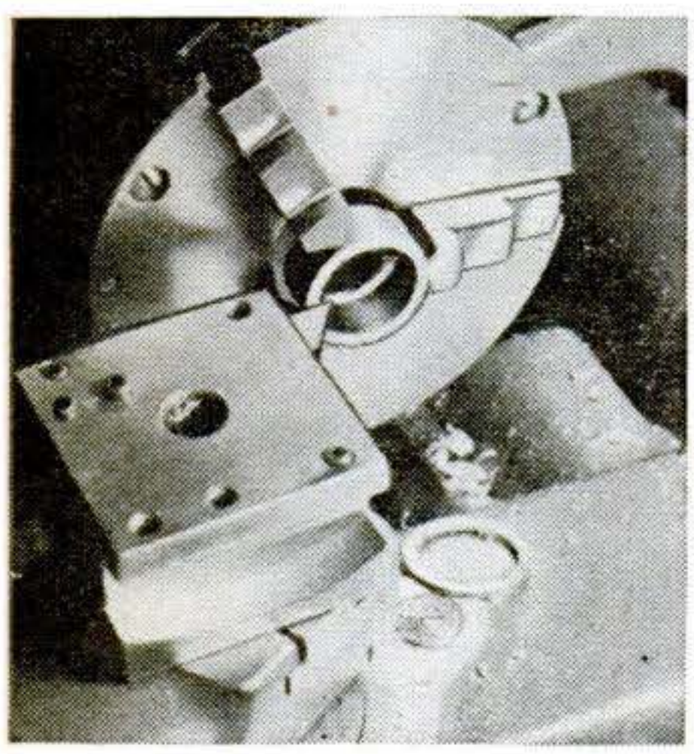
Block Tool Holder FOR TOUGH LATHE JOBS

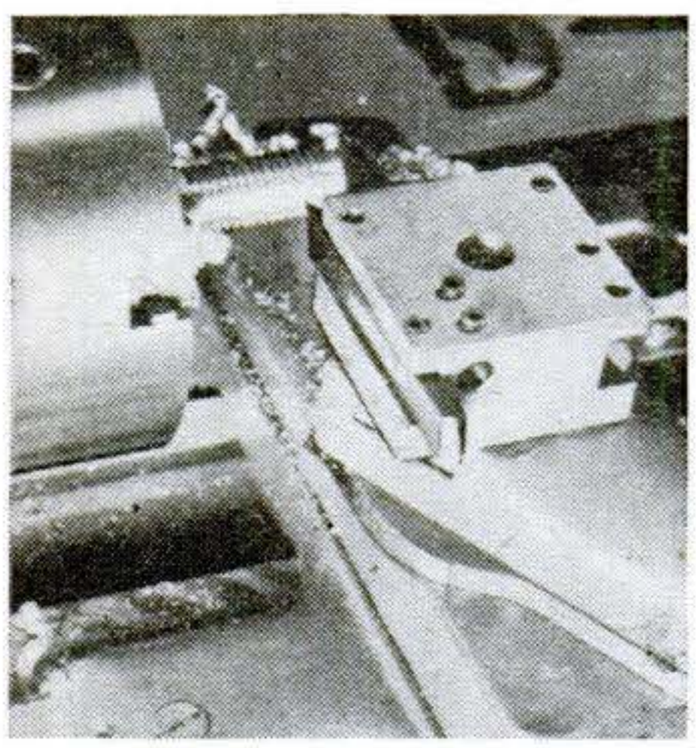
PRECISION lathe work difficult to accomplish with an ordinary tool post is simplified by this block holder, which provides an extremely rigid support for the tool. It is especially useful for parting-off work, quick thread cutting, fine reaming, and finish-facing.

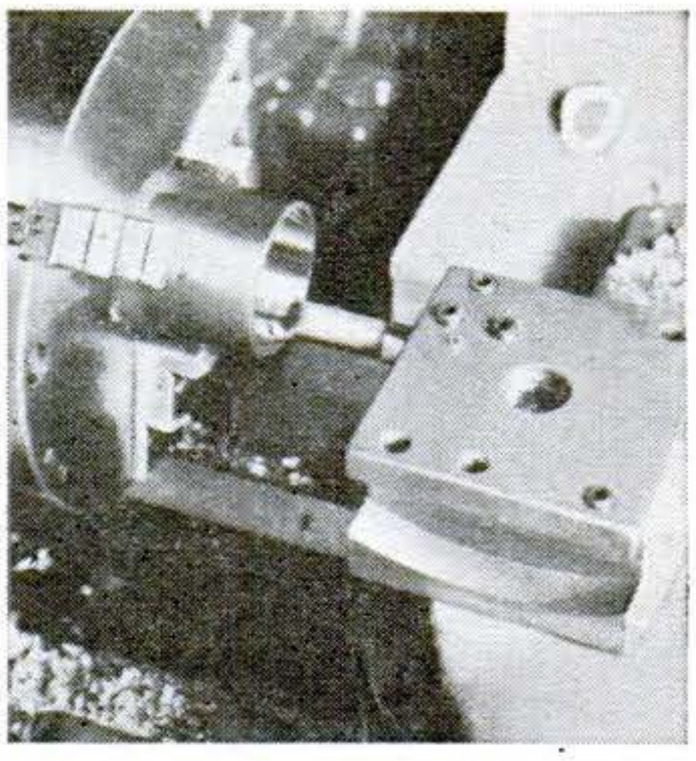
To make the holder, mill on a 1½" by 2½" by 2½" steel block a slot ½" wide by 5/16" deep, located 5/16" from the top edge. On the opposite side of the block, mill another slot, ½" wide by 7/16" deep and 5/16" from the top edge. Clamp the piece to the face-plate and turn out the bottom of each slot to a 3 3/16" radius and a depth of 5/16" and 7/16" respectively for the rocker arm. The several holes are then drilled, tapped, and counterbored to the specifications listed in the drawing below.

The clamp, a ½" by 1¼" by 2½" steel shoe, and a ⅜"-16 hollow-head setscrew are used to secure the holder on the compound rest in alignment with the ways. With a drill in the chuck, drill the boring-bar hole and ream it to .375". The rocker arms are made by cutting suitable stock to 2½" in length and turning the 3 3/16" radius on the lathe.

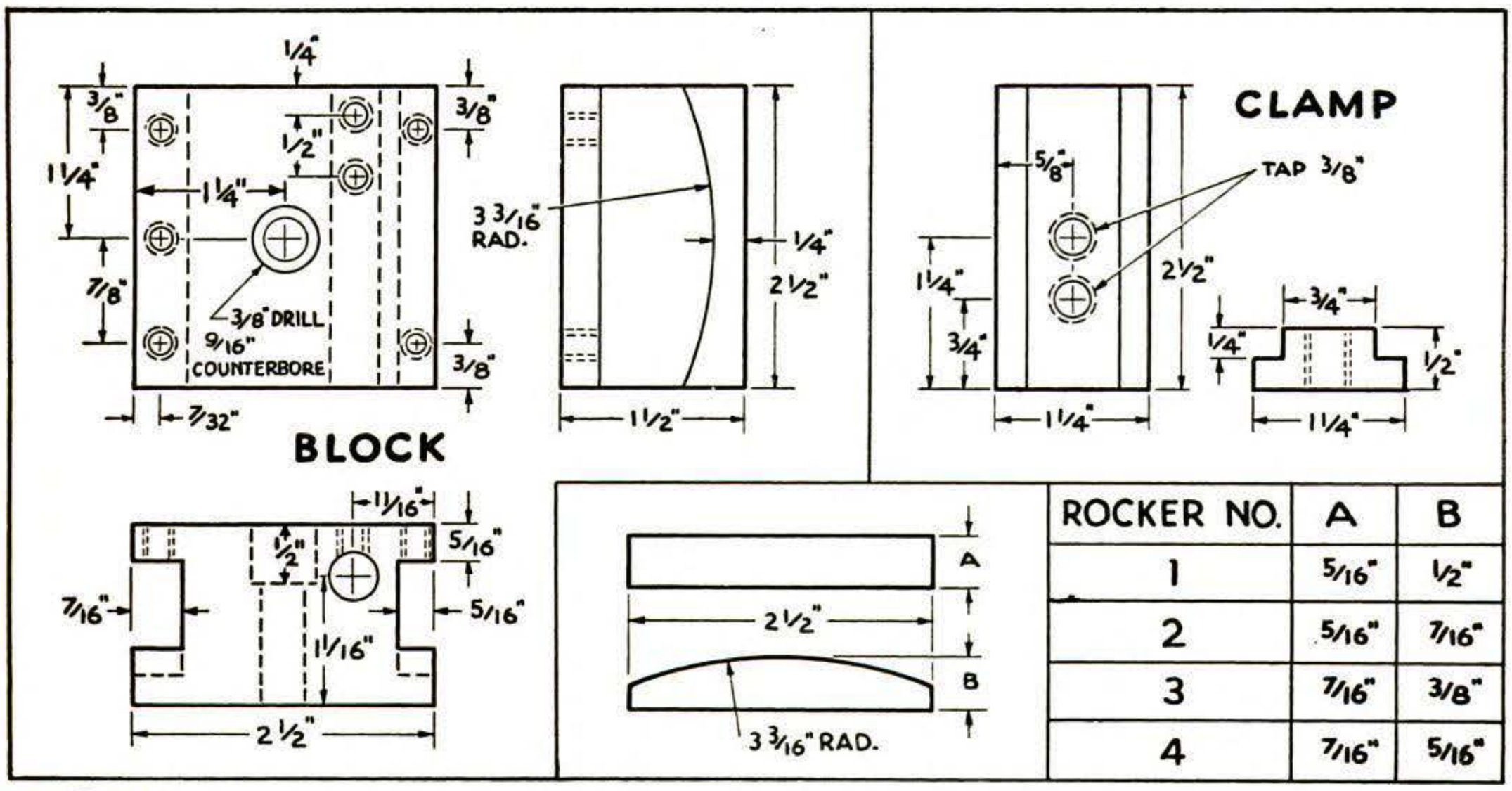
Dimensioned as above, this holder is designed for a 9" lathe with a separation of 1 1/16" between the lathe center and the top of the compound rest. If this dimension is greater on your lathe, add the difference to the 1½" height of the block and the 1 1/16" dimension locating the boring-bar hole. If







The holder demonstrates its versatility above. Left, it cuts close to the chuck jaws; center, it turns clean, accurate threads without chatter marks; and right, it bores out thin-walled tubing to a very high finish.



ROCKER NO.	A	B
1	5/16"	1/2"
2	5/16"	7/16"
3	7/16"	3/8"
4	7/16"	5/16"

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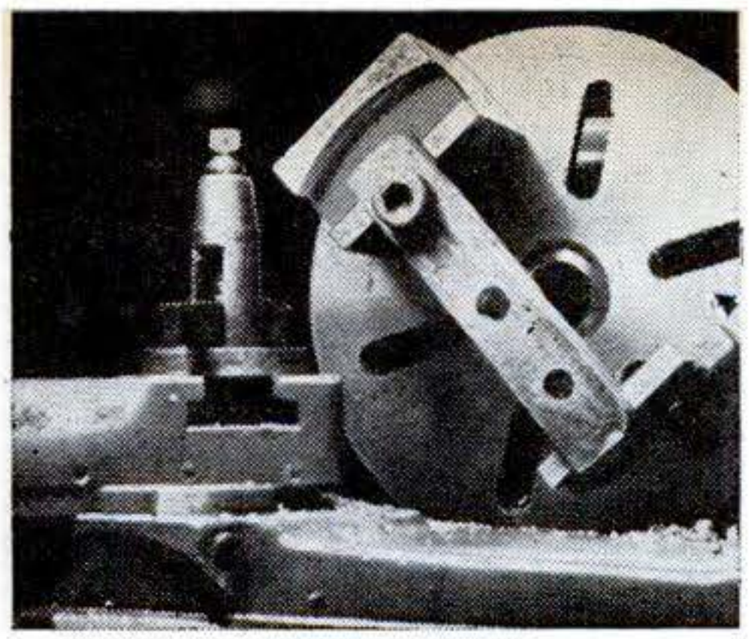
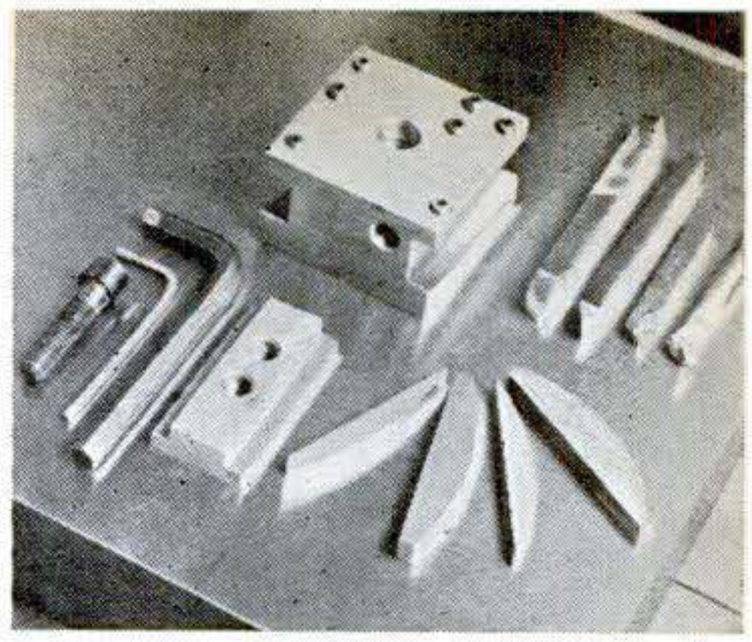


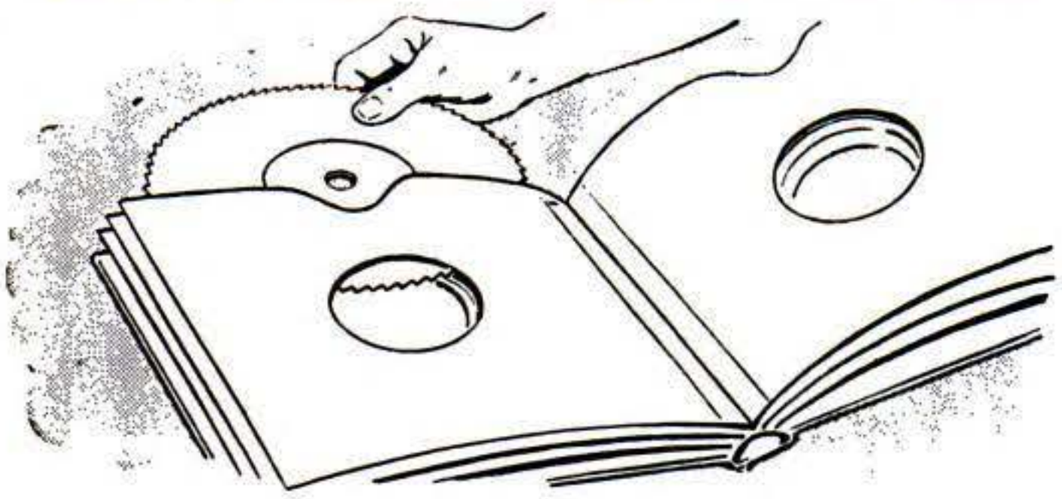
With the block clamped to the edge of the lathe faceplate, the curved slots to hold the rocker arms are turned.

By varying the dimensions of the slots, this holder could take tools larger or smaller than those shown.

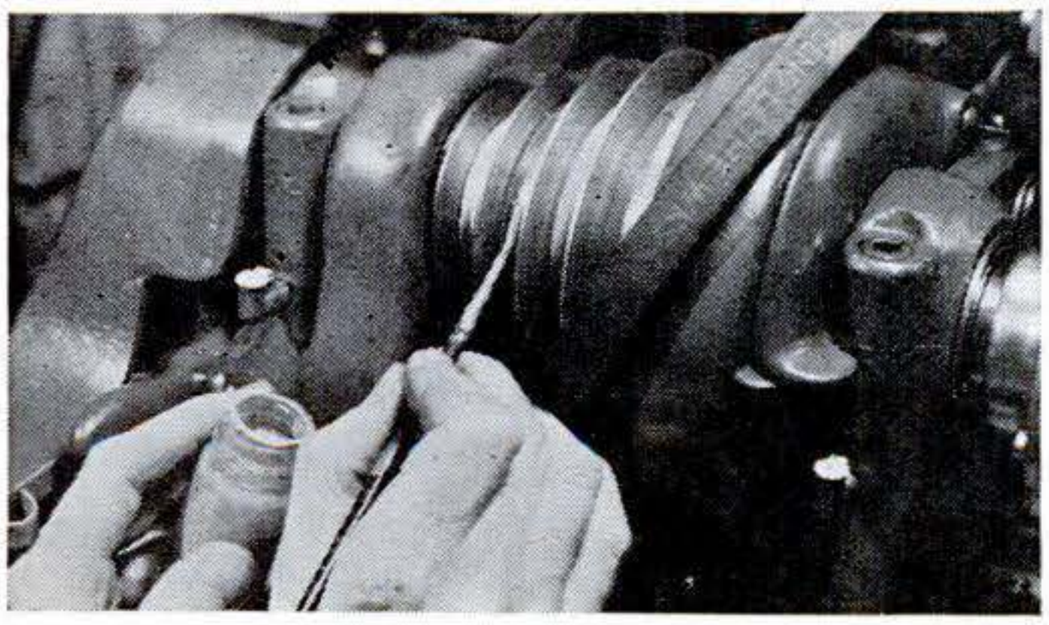


the separation is less, subtract the difference. The height of the boring-bar socket will automatically be right if this is drilled as described above. By changing the size of the rocker arms and the depth of the tool holder slots, the block holder could be adapted to a number of tools of various dimensions. Made to the specifications given, it will accommodate tool bits ranging from ¼″ by ¼″ to ⅜″ by ½″. If care is used, the ⅜″ hole can be enlarged to ½″ for boring bars of that size—J. C. MAGEE.

Record Album Holds Saw Blades

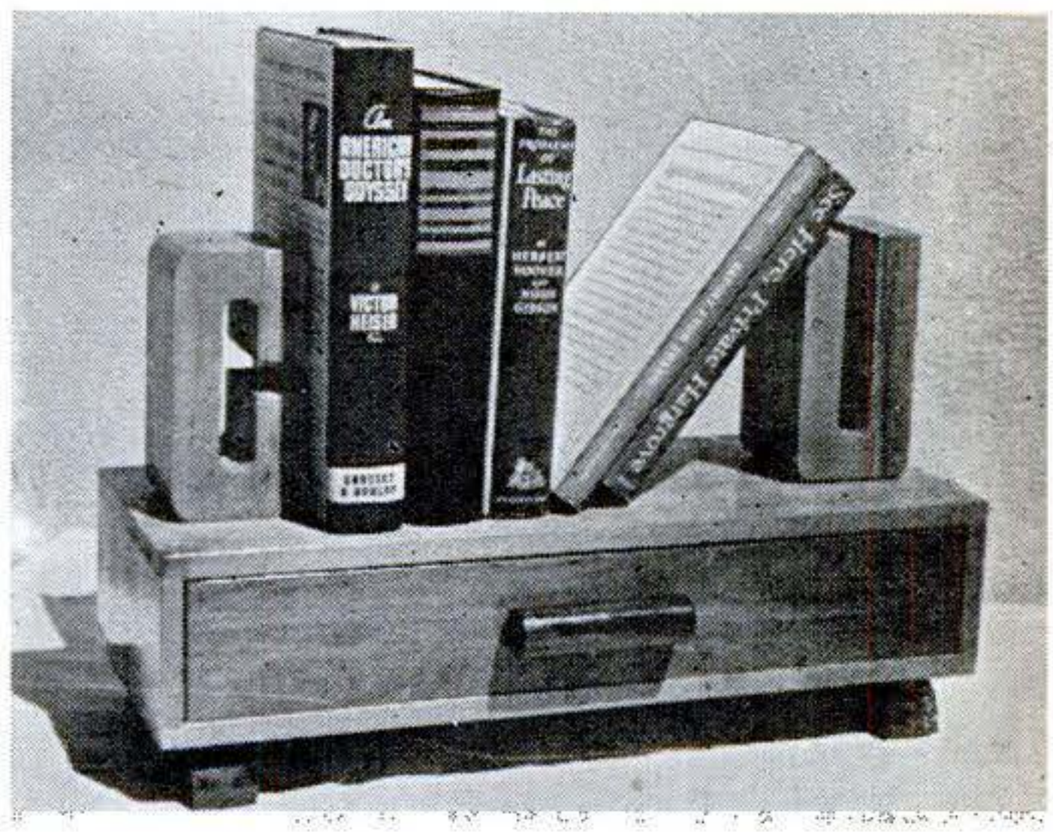


FINDING the right circular-saw blade is as simple as locating a favorite phonograph recording if you store them in a discarded record album. The envelopes protect the blade teeth.—RICHARD SALZER.



Colors Align Cone-Pulley Belt

TIME-WASTING errors in aligning V-belts on multiple-step cone pulleys can be avoided by coding the bottoms of the pulley grooves with paint. With both the spindle and jack-shaft pulleys coded alike, the lathe operator merely makes certain the belt rides in two grooves of the same color.



Bookstand Has Storage Space

NEAT storage for stamps, stationery, and even a bottle of ink is provided in this attractive combination of bookstand and drawer. The book ends might be personal initials or school letters.

Dimensions can be adjusted to the available space on your desk, and any good wood could be used. For the stand illustrated, three different woods provide eye-appealing color contrast. The 4″ by 18″ by 7″ deep chest was made of ½″ gum. Two letters were bandsawed from 2¾″ by 2¾″ by 5½″ pieces of oak. Walnut was employed for the turned ¾″ dowel pull and the bandsawed feet.

Assemble by screwing the letters to the top and then gluing the top to the rest of the chest. Sand well and finish with one coat of shellac followed by two coats of varnish, buffing each coat after it has dried well.—W. H. FULKER.

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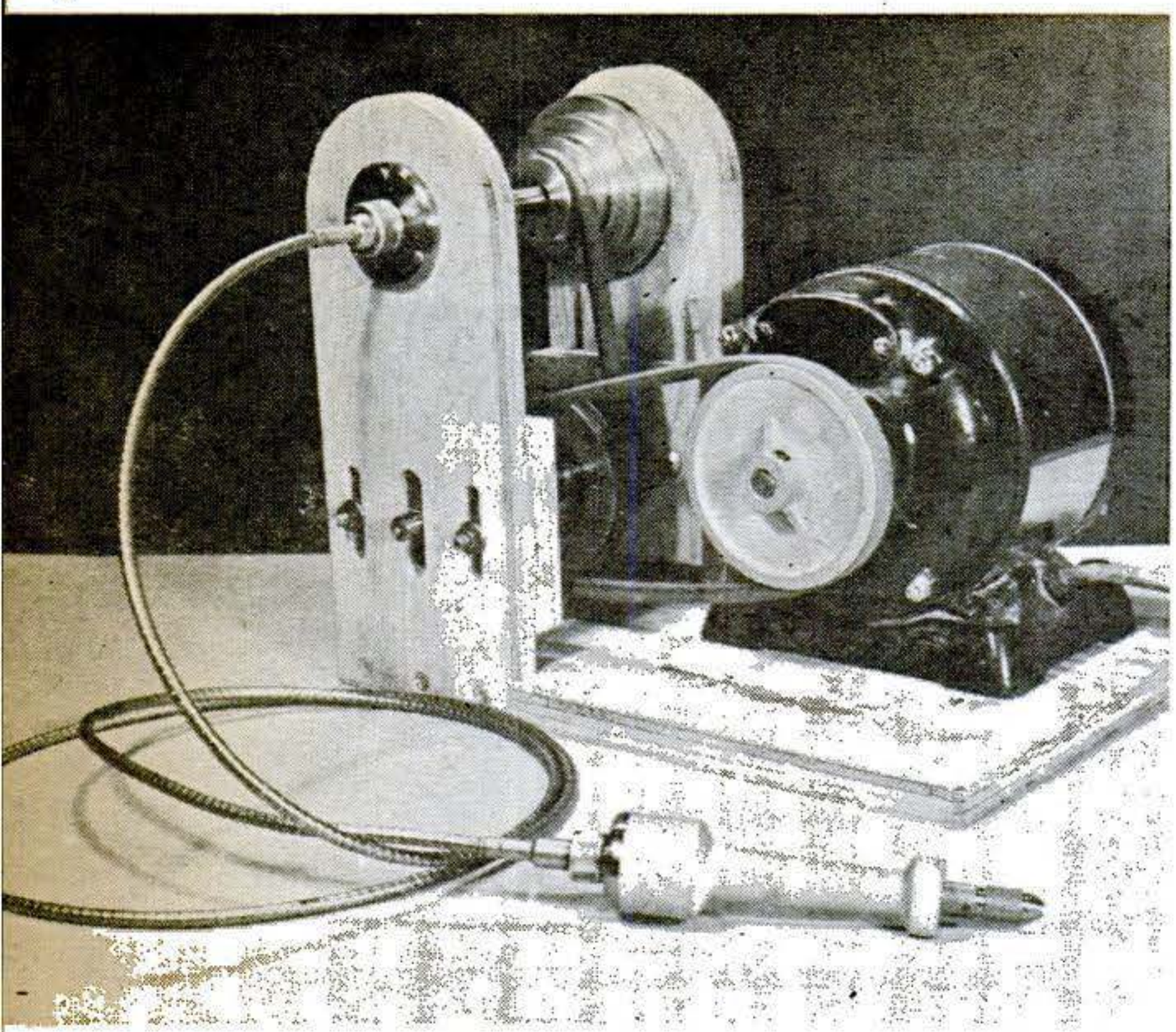
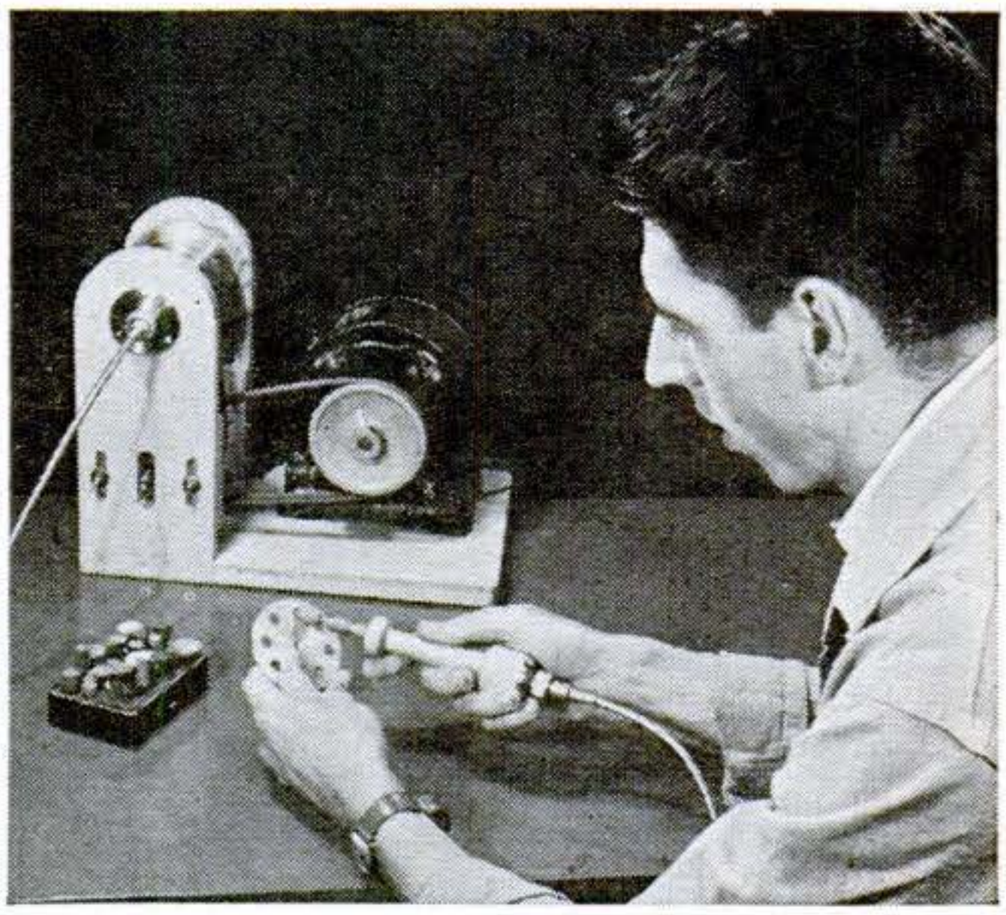


Built to handle a variety of roughing and finishing tools, this little grinding head will run at speeds of 700 to 9,000 r.p.m. when driven by a 1,750-r.p.m. motor rated at ¼ hp. or more. The motor is readily detachable for other shop uses.



FOR ROUTING, GRINDING, AND POLISHING IN TIGHT SPOTS, THIS HAND-SIZE ARBOR BRINGS POWER RIGHT TO THE WORK

Flexible-Shaft Tool

USES SPEEDOMETER CABLE

By Frank McCarty

SO MANY uses can be found for a hand grinder that, once a home-workshop owner has one, he wonders how he ever did without it. The grinder shown here will rout, etch, grind, take off burrs, and polish, and it will get into tight corners inaccessible to other tools. A variety of grinding wheels, buffing and polishing wheels and brushes, burrs, and saws—all with ⅛″ shanks—can be obtained for it.

The tool can be built in your own shop and connected through a flexible speedometer cable to a jackshaft driven by any shop motor on hand. Speeds of 700 to 9,000 r.p.m. can be taken off the stepped pulleys in the jackshaft assembly. With either the flexible shaft or the driving pulley detached, the motor will still be available for use with other machines.

A flexible cable about 80″ long for 1937 or later cars can be purchased from an automobile-supply dealer for less than $2. Ball bearings will also have to be bought, and they are absolutely necessary for the high speeds involved. If you can't obtain ½″ bearings, get SAE bearings in metric measurements. For the jackshaft, 14-mm. (.551″) bearings can be used if the hole is reduced to ½″ with a sleeve. Bearings for the grinder shaft are 8 mm. (.315″), and the shaft is turned to a snug push fit in them. If it is accidentally turned too small, the areas fitting into the bearings can be enlarged by knurling them lightly.

Maple, hard birch, or other hardwood is used for the handpiece body and will be found stronger and less likely to shatter if dropped than most plastics. Turning is simplified by making the body in three sections. Screw the end blocks to the faceplate through waste, turn to fit the bearings, and bore the ½″ hole through. The center section is first drilled 7/16″ and then turned on a dowel arbor until it fits snugly into the ends. Assemble the three pieces with waterproof glue and turn to final shape.

For the shaft, a length of 7/16″ drill rod or mild steel is centerdrilled at both ends and

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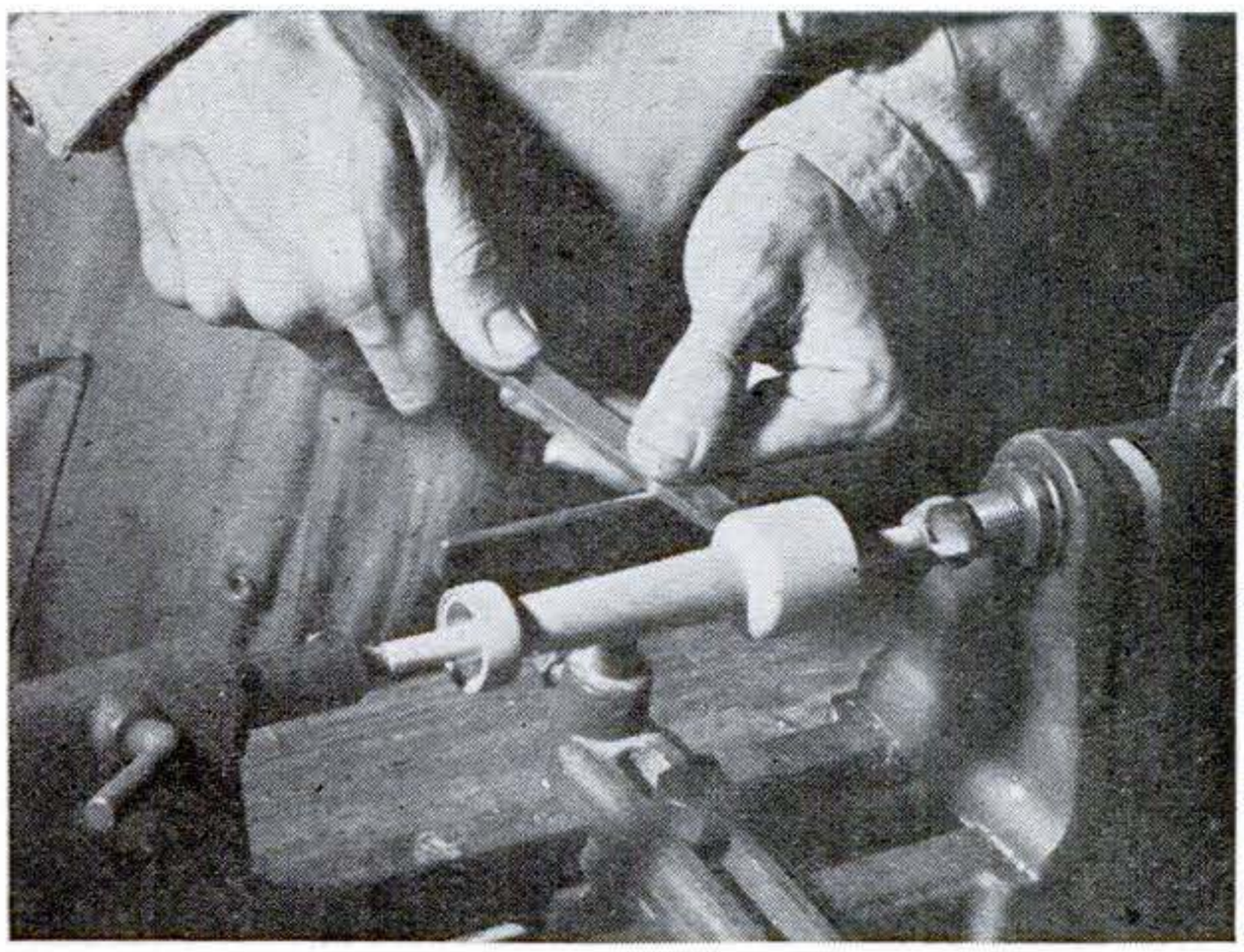
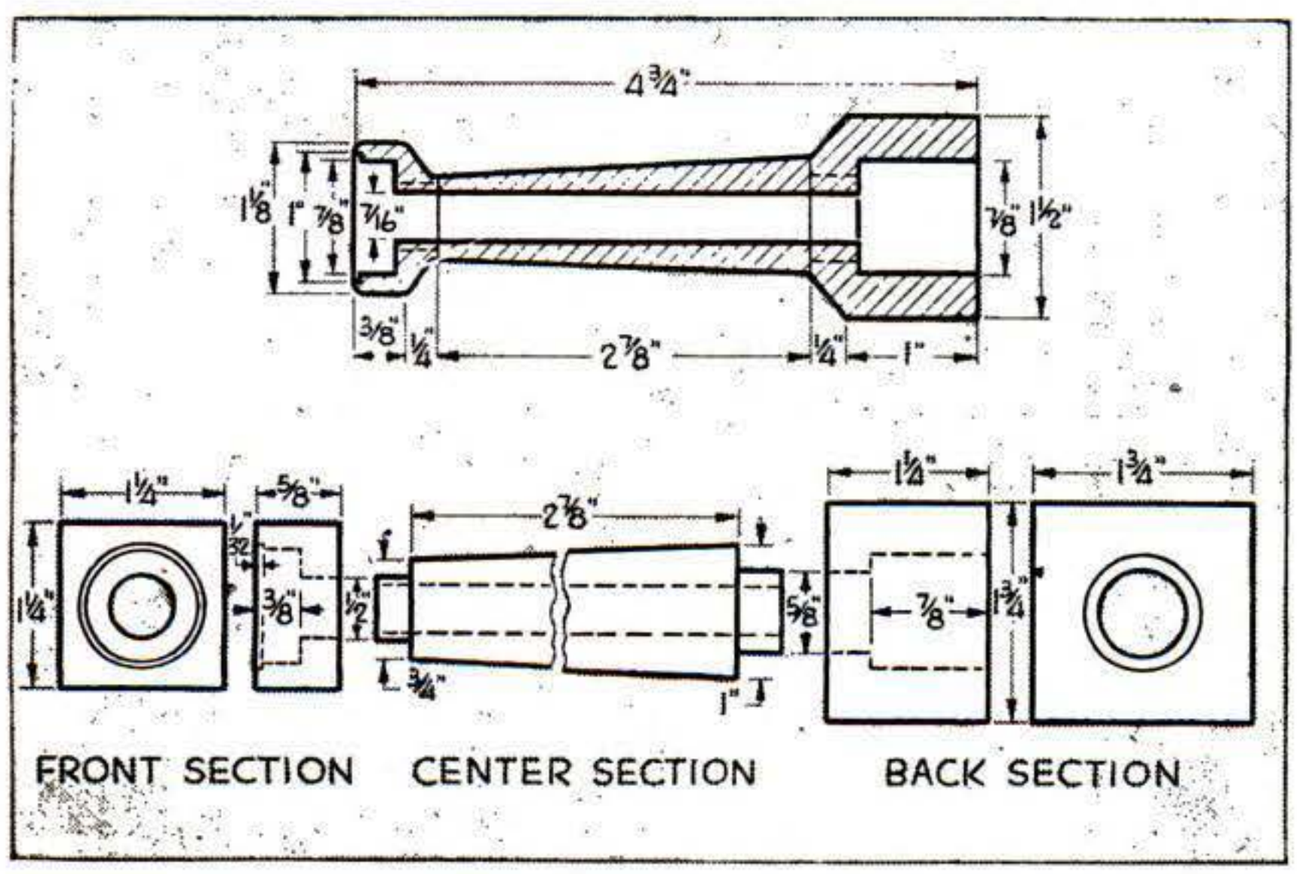
turned and threaded between centers of a screw-cutting lathe. It is inserted in a 5/16″ collet for drilling the 5/16″ hole and then reversed in the collet for drilling the ⅛″ hole at the other end. Three equally spaced slots are cut on the threaded end of the shaft with a fine metal-cutting saw, and the shaft is completed by drilling a 3/32″ hole across the large end and fitting a pin in snugly to take the slotted end of the flexible-shaft driver.

To make the handpiece chuck, start with a short length of ½″ drill rod held in a collet. Knurl the piece first, and then turn the two 7/16″ diameters. After centerdrilling, drill with a 5/32″ drill and follow with an I drill (.272″) sharpened to a 60-deg. point. Tap the larger hole 5/16″-24 and drill out the end threads with a ⅜″ drill to a depth of ¼″. Cut the piece off 1″ long; then face the front and turn the angle with the work held in a 7/16″ collet as final operations on the piece.



Hardwood used for the handpiece body will give it considerable strength. The piece is made in three parts, glued up, and then finish-turned to shape on a dowel arbor.



The shaft collar is knurled and turned on stock left from the chuck, and then drilled and cut off. Drill through the knurled wall with a No. 38 (.101″) drill and tap 5-40 for a headless setscrew ⅛″ long. If socket-head setscrews cannot be obtained for this and other setscrew holes, standard machine screws can be cut down and slotted.

A thin slice cut off 1″ bar stock and drilled ⅜″ to go over the .315″ shaft will serve as a retainer on the chuck end. Or the retainer can be made by drilling a disk cut from 1/32″ sheet metal.

Stock for the coupling flange is drilled and pressed on an arbor for machining. The radius is best turned freehand with a file ground to a chisel edge. Turn the thread ⅝″-20 to fit the flexible-shaft coupling, after taking a cut next to the base wide enough to end the thread. Three ⅛″ holes are drilled near the edge of the base and countersunk with a ¼″ drill for No. 5 roundhead wood screws ⅞″ long. It is easier to drill them before the radius is machined.

Drivers will be needed to couple the ⅛″ square ends of the flexible shaft to the grinder and jackshaft. They are made from 1″ lengths of 5/16″ drill rod held in a collet and drilled to a depth of ½″ with a No. 29 (.136″) drill. The opposite end is slotted. A headless setscrew in a 5-40 tapped hole attaches each driver to its end of the flexible shaft.

To assemble, first install the bearings tightly in the wooden body, insert the shaft from the larger end, and screw on the flange. Slip on the bearing retainer and shaft collar at the chuck end, tighten the setscrew, and screw on the chuck. Tightening the chuck by hand will close the split shaft enough to grip the shank of a tool, but if desired, flats can be filed on opposite sides of both the chuck and collar to accommodate small wrenches.

The jackshaft or variable-speed assembly has a frame of ¾″ plywood. Bore the uprights to fit the ball bearings snugly, cut three slots in each, and groove the inside faces for the rails. Saw out, bore, rout out, and groove the ad-

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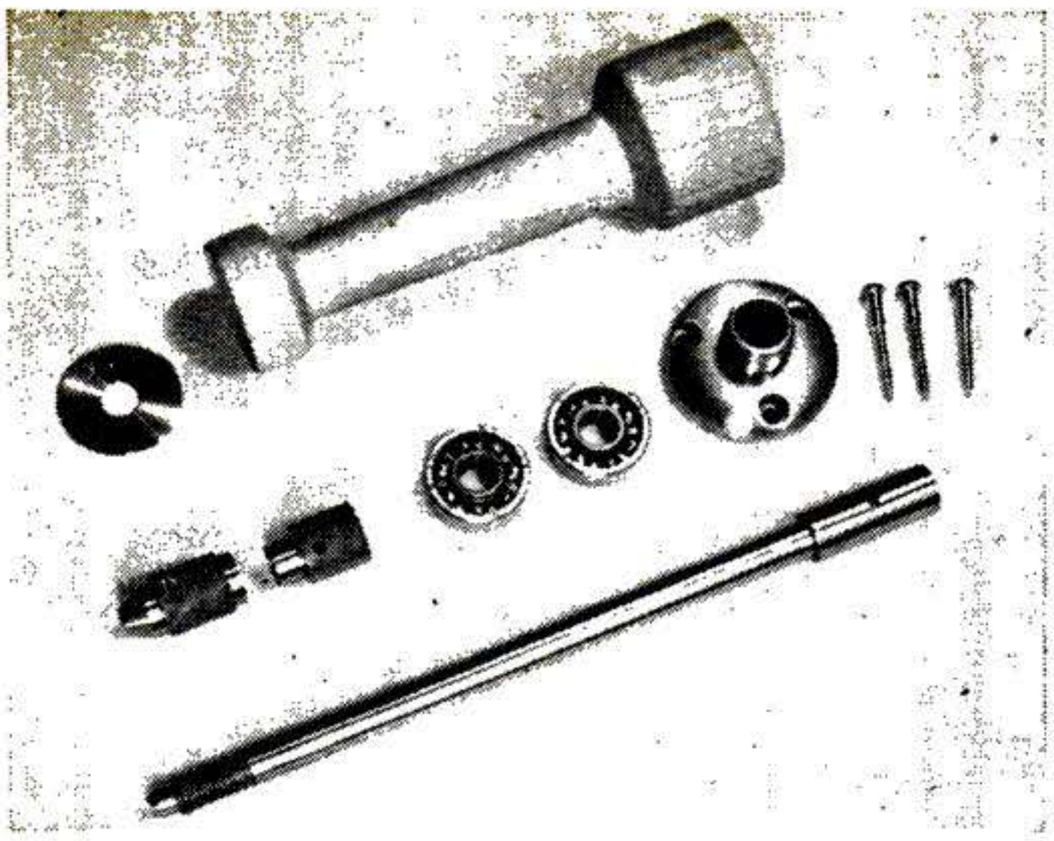
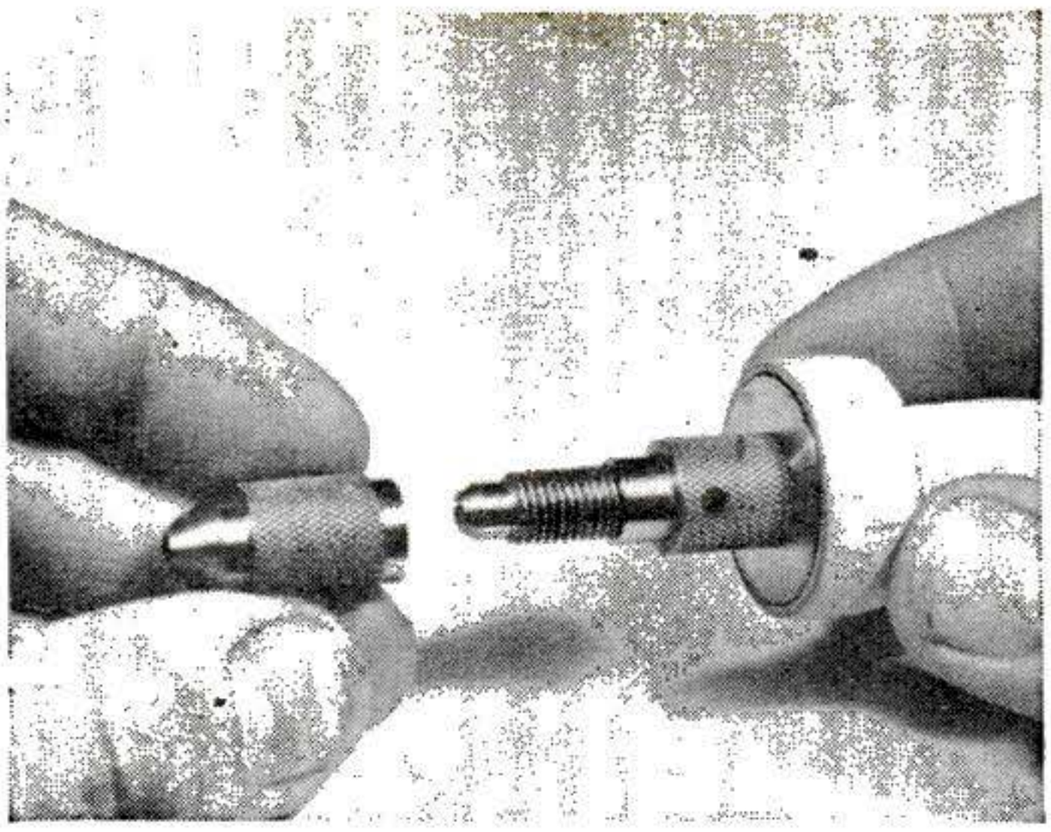
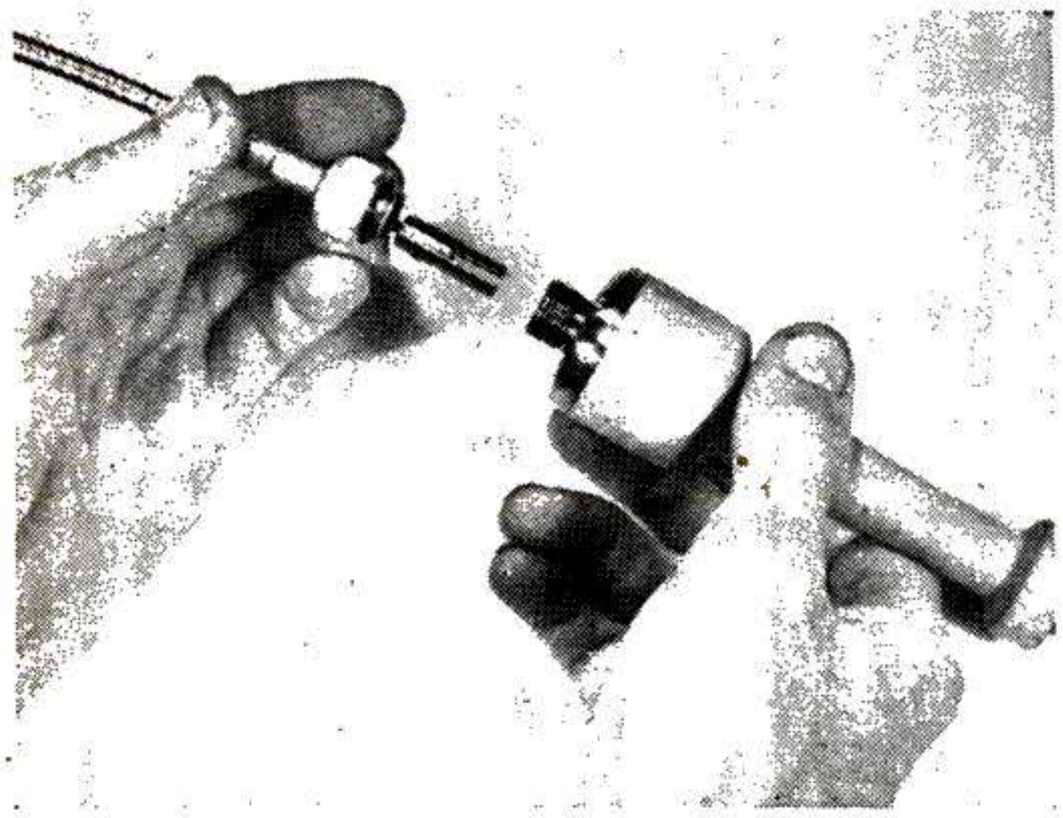


The handpiece consists of a body, a threaded shaft, chuck, collar, bearings, retainer, and coupling.

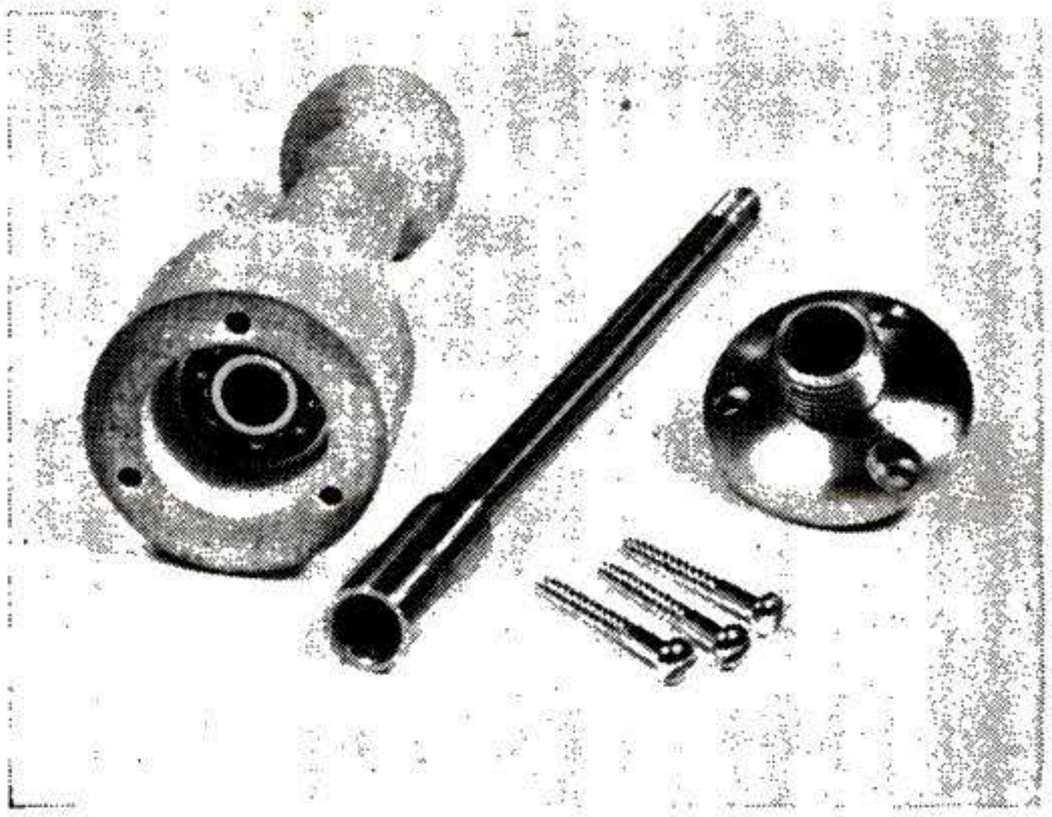


With the shaft inserted, the retainer is pressed against a bearing and the collar and chuck put on.

The flanged coupling is screwed on the larger end. A driver connects the speedometer cable and shaft.

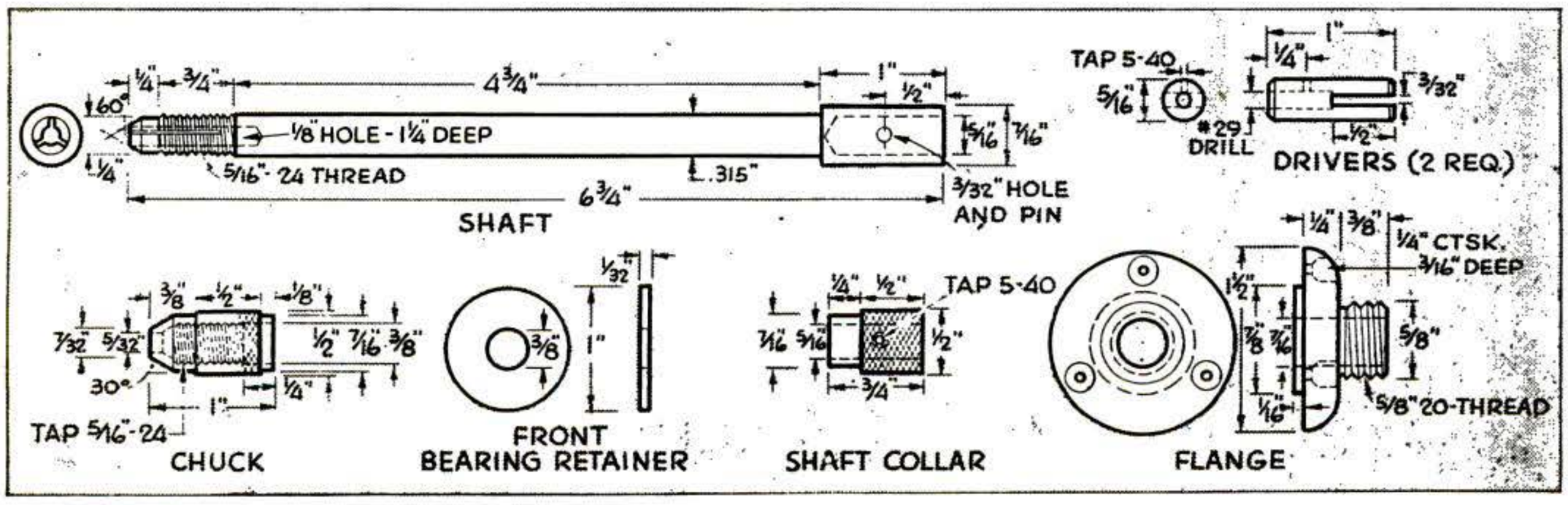


Below, the rear bearing can be seen in the body. The shaft is pushed in from this side on assembly.



justable bearing plates, and fit in ⅜″ by ¾″ rails by means of which they will slide up and down in the grooves in the uprights. The routed central portion should be deep enough for the rectangular retainers to fit in flush. Four ¼″-20 carriage bolts hold the plates to the uprights and permit clamping at the required position. Rectangular hard-composition retainers are placed only between the plates and uprights; the five other retainers required are disks cut from the same material. The flexible shaft coupling flange serves as the eighth retainer.

Two shafts will be needed, both ½″ in diameter and 8½″ long. The upper one from which the flexible shaft takes its power is drilled 5/16″ and fitted with a 3/32″ cross pin for the slotted driver. Follow the same



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procedure outlined for working the coupling end of the grinder shaft.

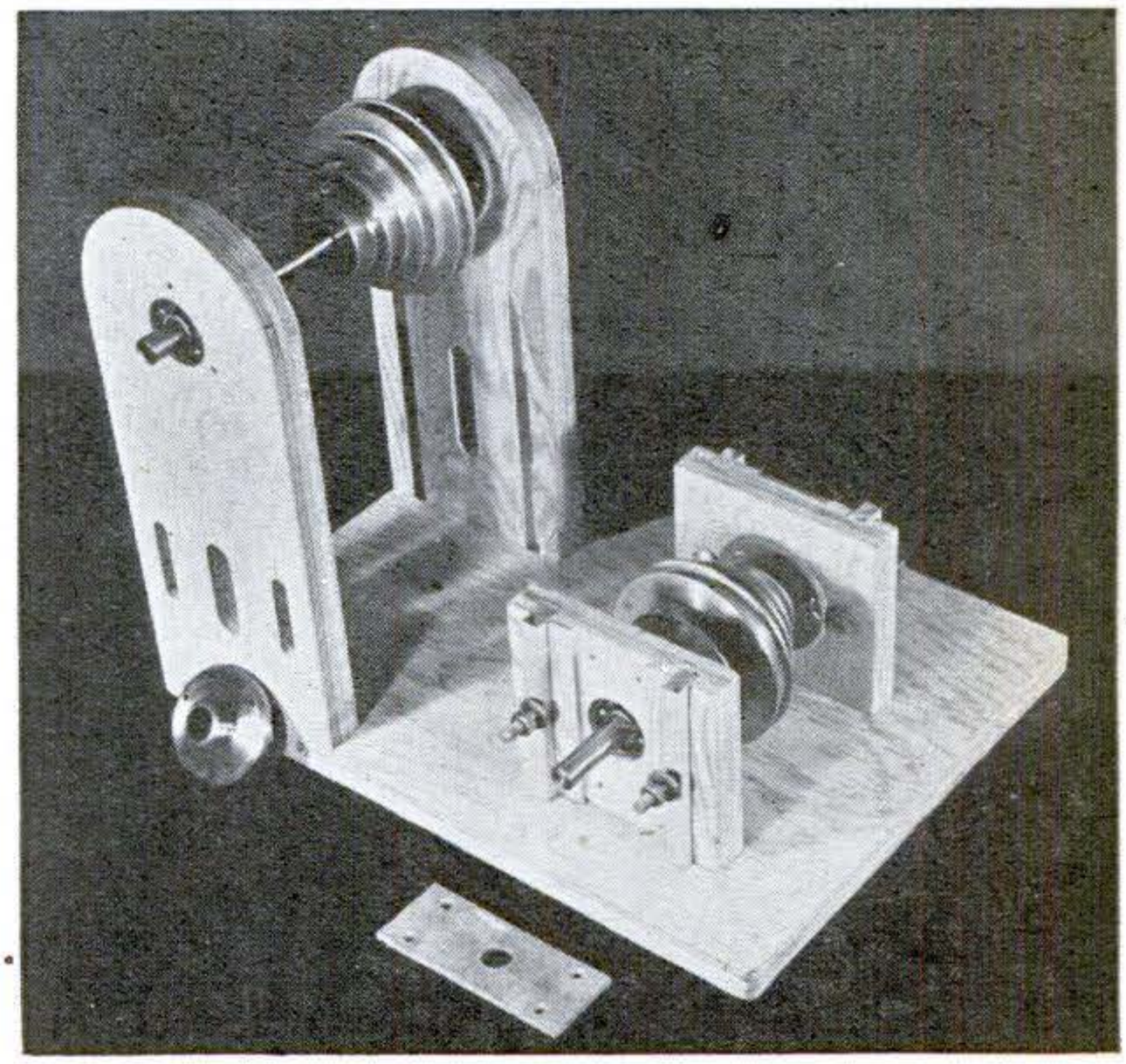
The coupling flange on the jackshaft is also similar to the flange on the grinder, but it is made on a larger scale. Drill the stock first, and then turn it on a ½″ arbor. The thread is the same pitch (20 per inch), but on a ⅞″ diameter to fit the other end of the flexible shaft.

Install all four bearings and screw retainers on both sides of all except the bearing on the coupling end of the upper shaft. The flange serves there instead. Fasten the two uprights to the base with No. 10 or other fairly long flathead wood screws, and clamp the plates to the inside with carriage bolts.

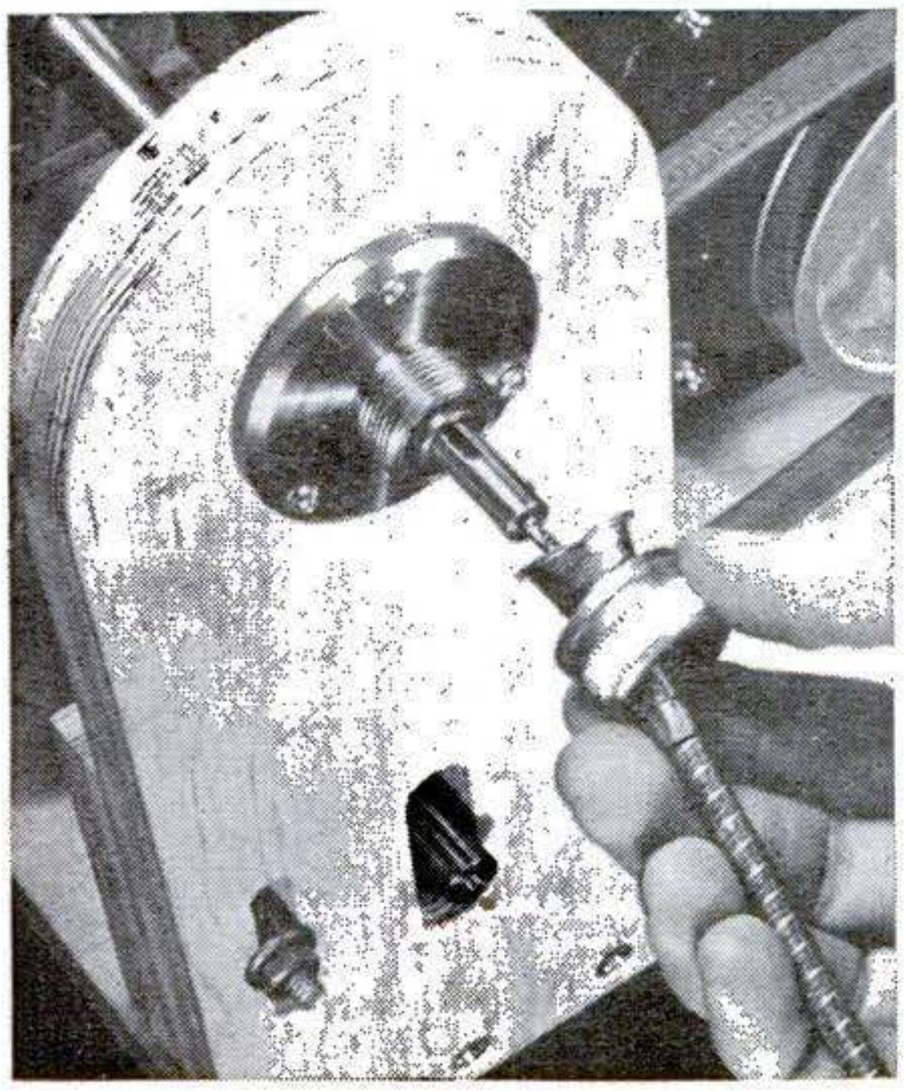
A pair of 4″ three- or four-step pulleys, a 2″ pulley, and a 4″ pulley are required, as are a 22″ V-belt and a 27″ motor belt. Push the lower shaft through from the back, put on a step pulley, the 2″ pulley, and the two belts, and push the shaft on through the second bearing. The step pulley is put on the upper shaft in reverse and the V-belt hooked over it. Tighten the belt by lowering the bottom shaft, and clamp the plates in position.

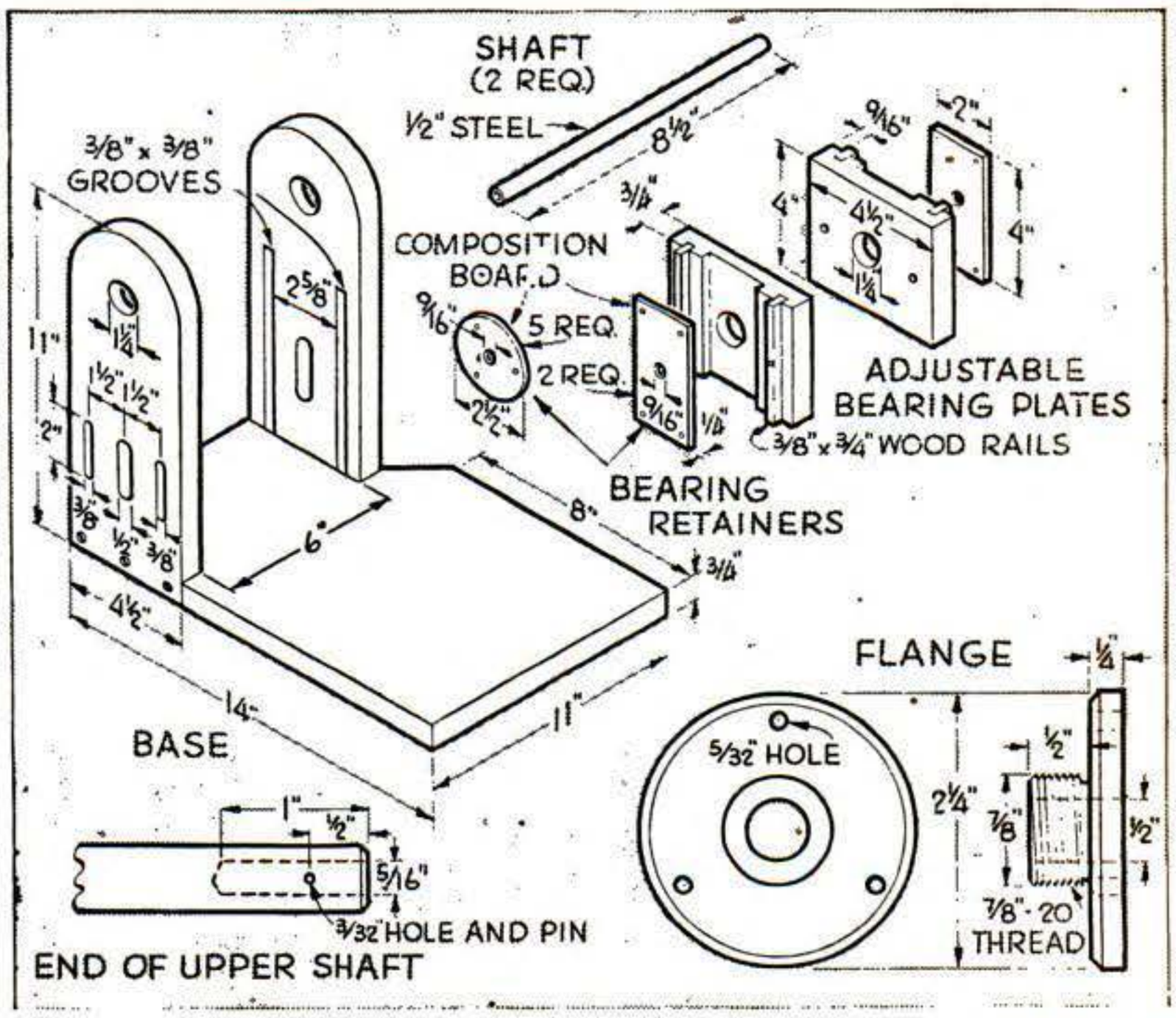
Place the 4″ pulley on the shaft of the motor, which should develop ¼″ hp. or better. Mount the motor by bolting directly to the jackshaft base, or use a floating motor rail by means of which it can hang and keep tension on the driving belt constant while the grinder is in operation.

All that remains is to couple the ends of the flexible shaft to the jackshaft and grinder, and the tool will be ready for use. The cable will be sufficiently long for the jackshaft to be placed on the floor. If it is used in this position, a foot switch can be connected to the motor within easy reach. Such an arrangement will be found exceptionally convenient. It's also a safety measure when work has to be hand held or is of a shape that may catch a buffing wheel or brush.



At right, the jackshaft unit with the lower shaft assembly not yet installed. Below, the flexible shaft is being coupled to the driving shaft.





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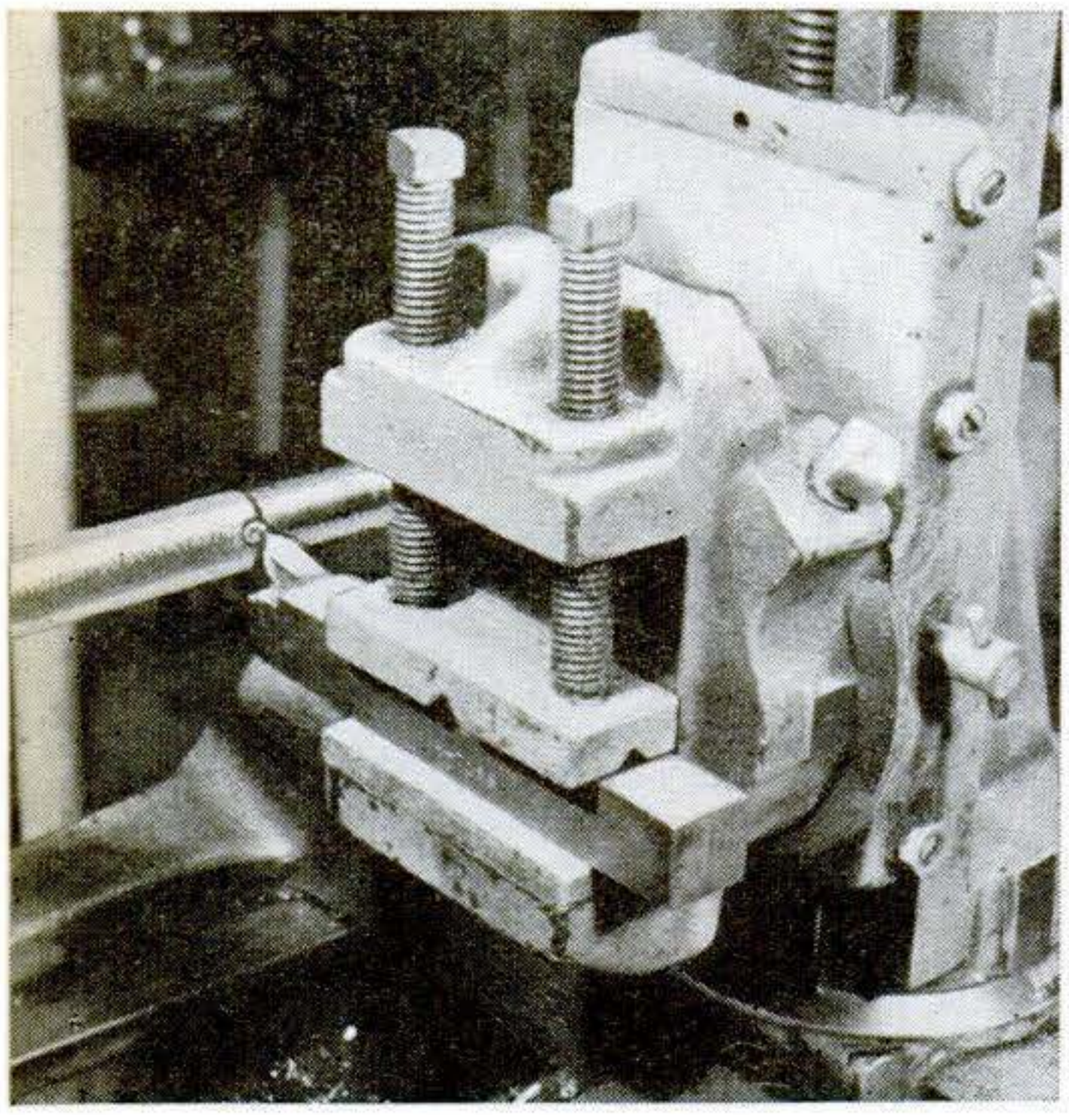
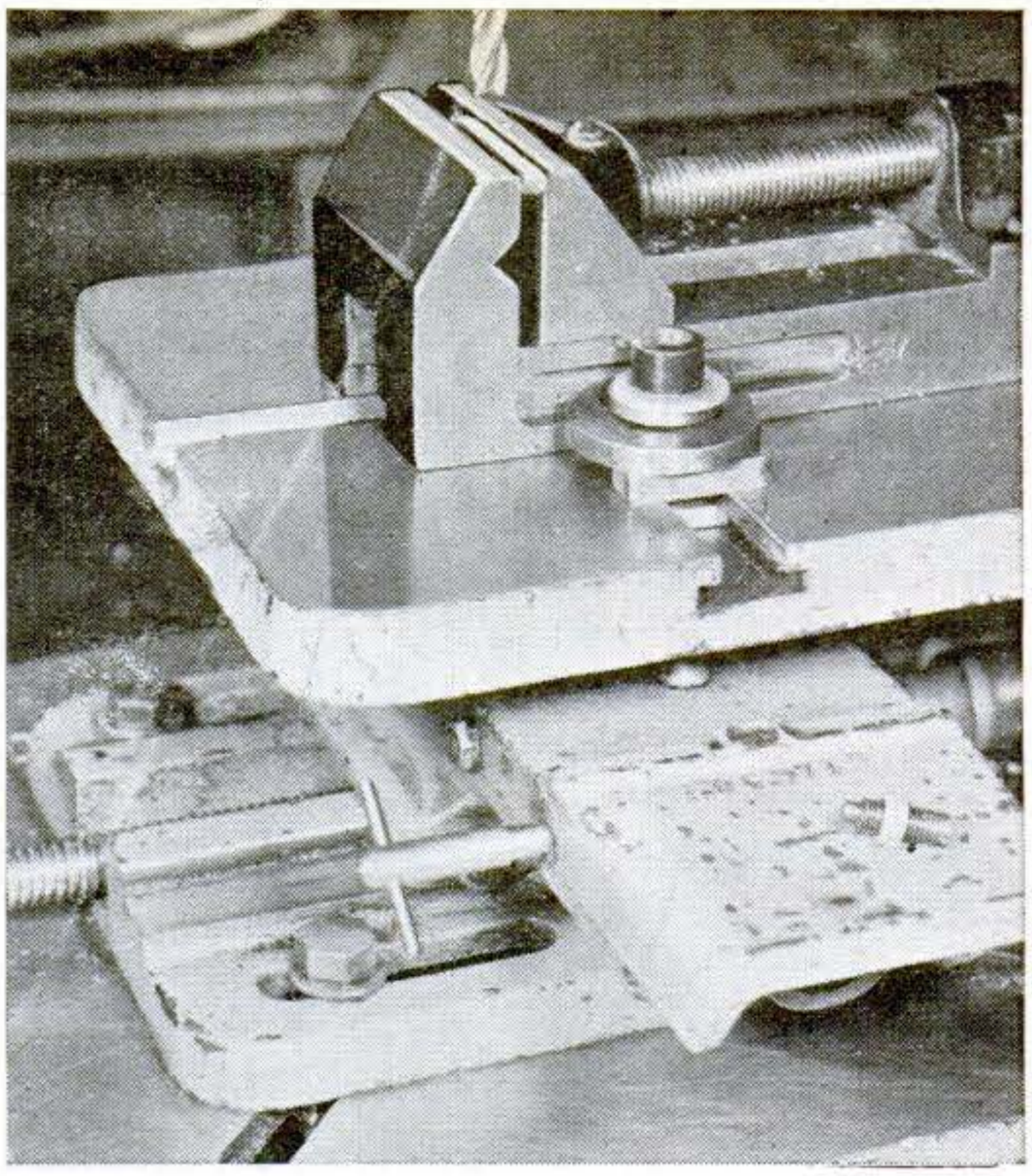
NEW SHOP IDEAS

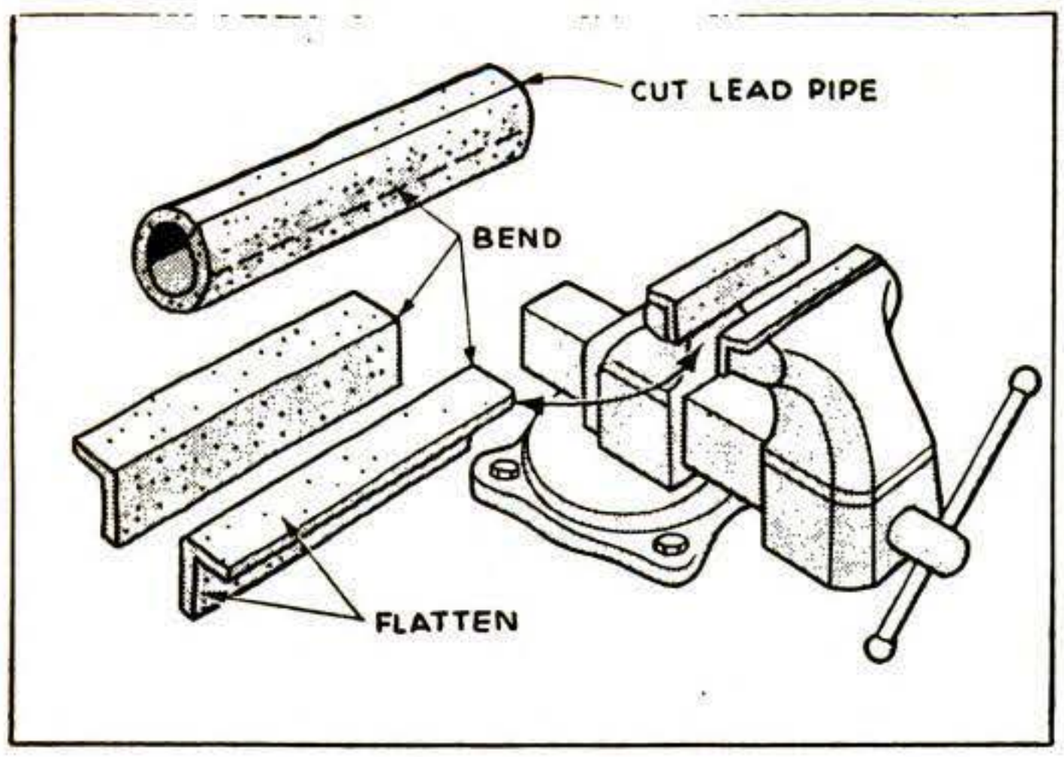


OVERSIZE LATHE TOOLS, including heavy carbide-tipped cutters, can often be picked up in used-machinery or surplus shops, but few home workshops have tool holders big enough for them. If a tool-post milling attachment is available, it will turn the trick. The tools can generally be mounted with more overhang than usual.—WILL THOMAS.



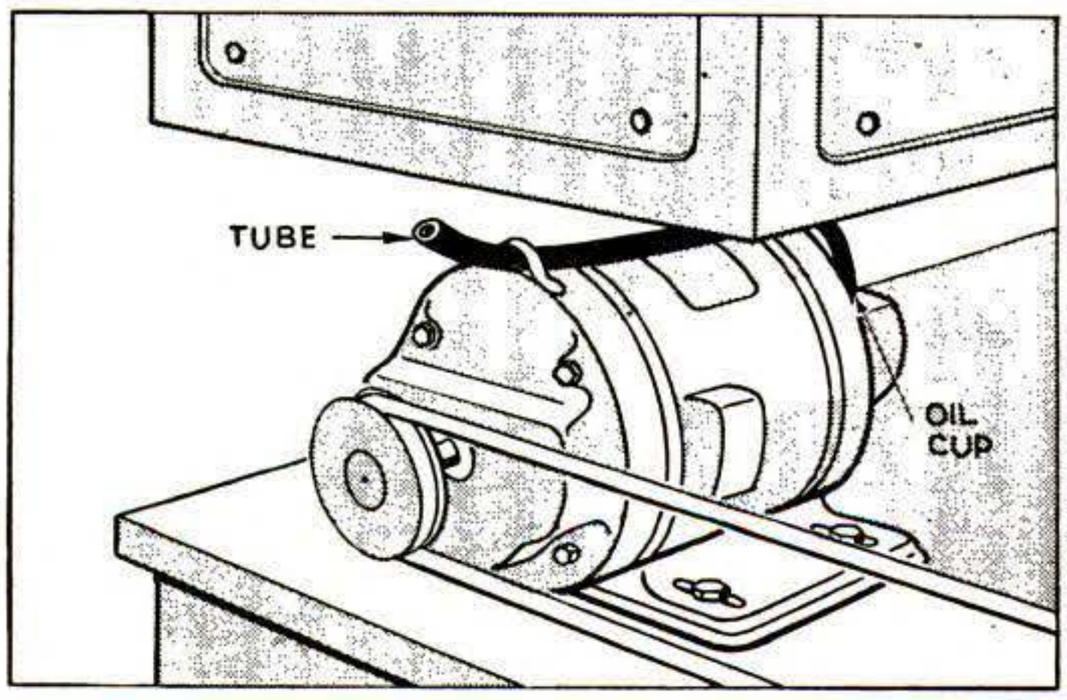
TIGHTENING A GIB SCREW to prevent ruining work on the milling table of a drill press can be a quick hand operation if you replace one screw with a special one having a handle. The screw should be made from a 2½″ length of ⅜″ diameter steel. One end is turned and threaded to duplicate exactly the original screw, and the other is drilled to a press fit for a ⅛″ by 1¾″ pin that provides a good grip for tightening and loosening.

It may be well to make a hand-turning gib screw for the transverse as well as the longitudinal feed if compound stresses are likely to be met.—J. C. MAGEE.



LEAD JAW FACINGS can be cut for a vise from a section of drain pipe and bent to L-shape to prevent marring of shafting and soft metals. Make an extra pair while you're at it, since the facings become battered with use.—RALPH S. WILKES.

OIL-CUP TUBES reaching to readily accessible places on machinery will make regular oiling a task less likely to be neglected. Such tubes may be cut from oil-resisting plastic or metal tubing and threaded into or otherwise attached to all out-of-the-way oilholes in the machines.—RONALD EYRICH.



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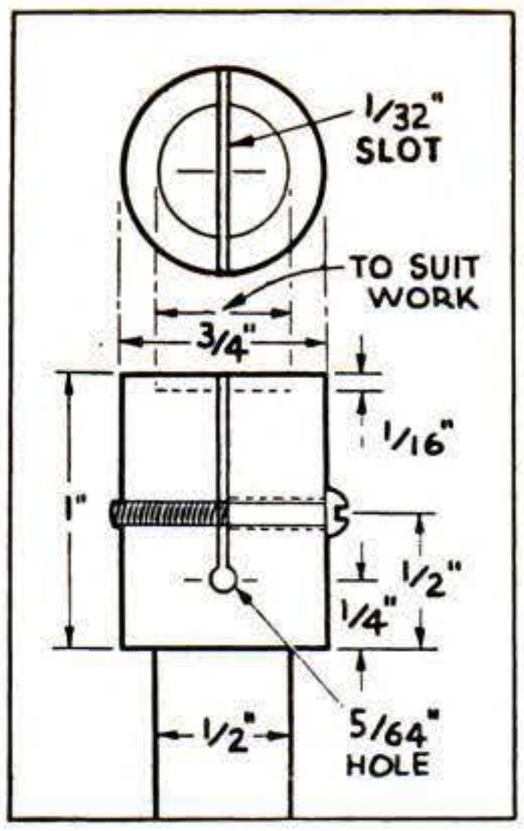
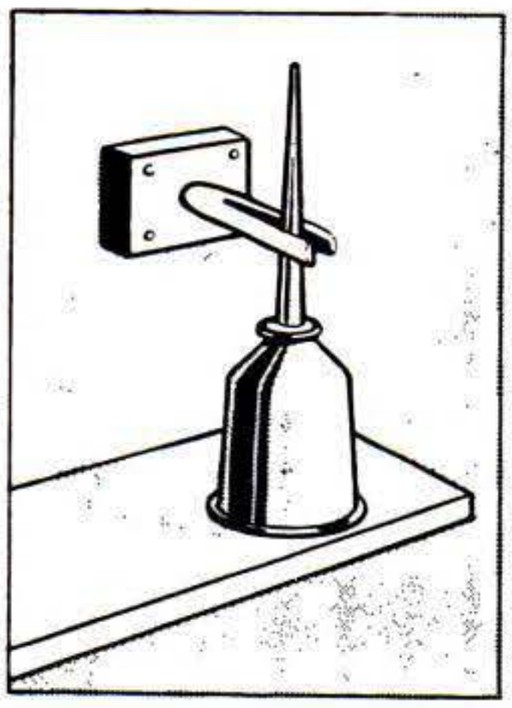
A SMALL CHUCK made up to hold disks that require facing or enlargement of inside diameters will save time when a quantity are to be machined, as for model-railway wheels. The chuck may be held in a collet or the shank held in a regular chuck.—J. F. GRECE.

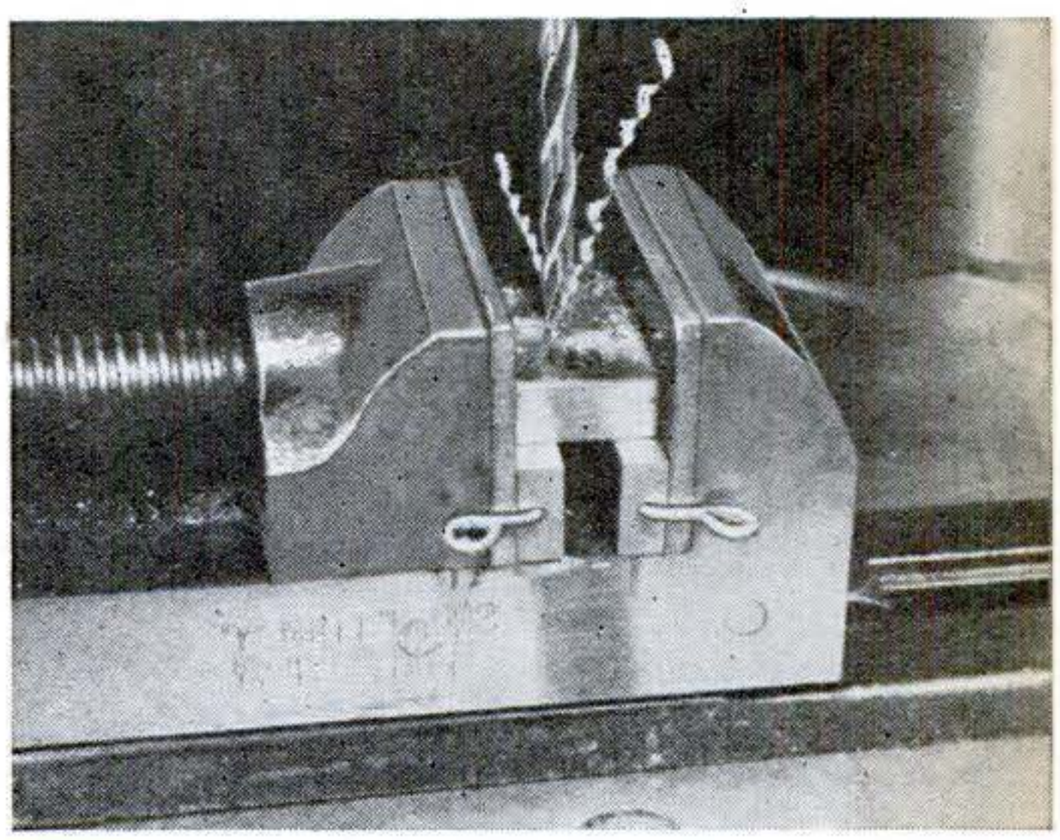




OILCAN RATTLE can be halted and the can will not fall off a vibrating shop shelf if the spout is held in a clothespin. The pin is set into a small block that has been nailed to the wall a few inches above the offending shelf or bench.

CLIPPED-ON PARALLELS won't fall over and delay work when the jaws of a drill-press vise are being adjusted. Any pair of steel parallels now on hand for use as a rest for the work can be improved with a simple set of wire clips.

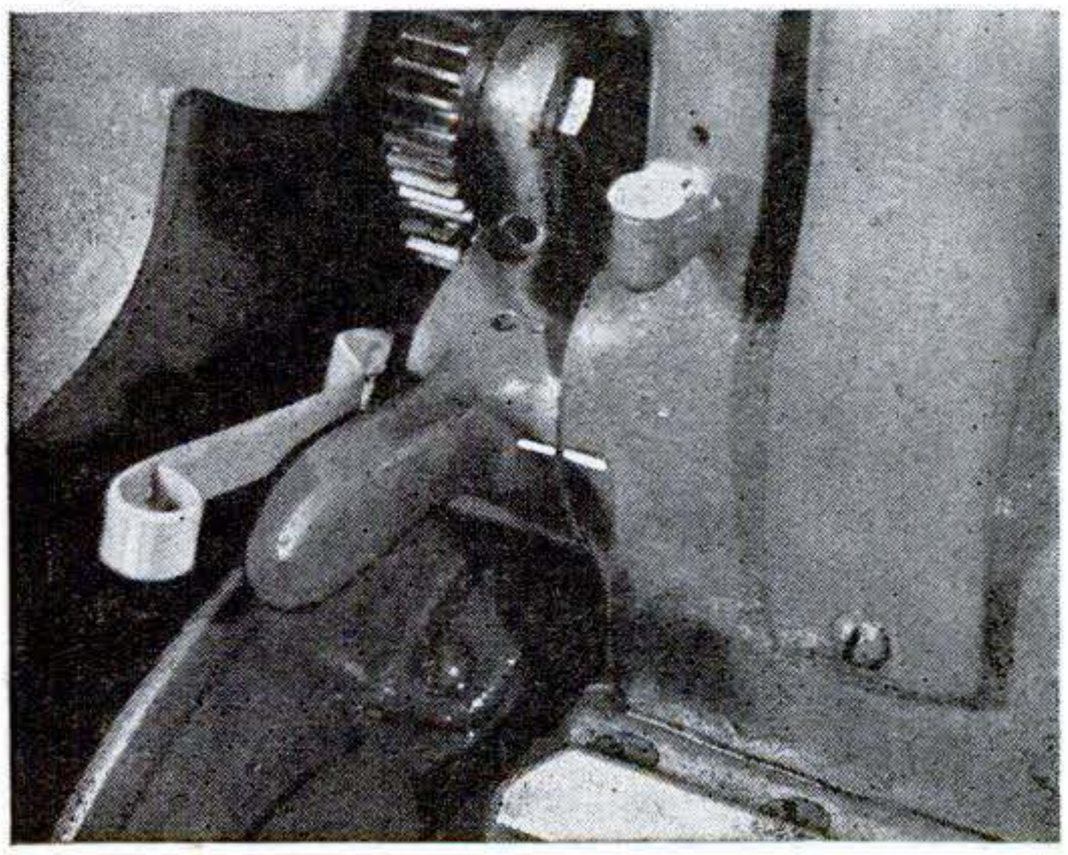
Make the clips of light steel or brass wire that has some spring. Bend a loop in one end and bend the other at right angles. Drill the ends of the parallels and press or solder the clips in. Seat the loops in dimples put in the ends of the vise jaws near the faces with a ¼" twist drill.

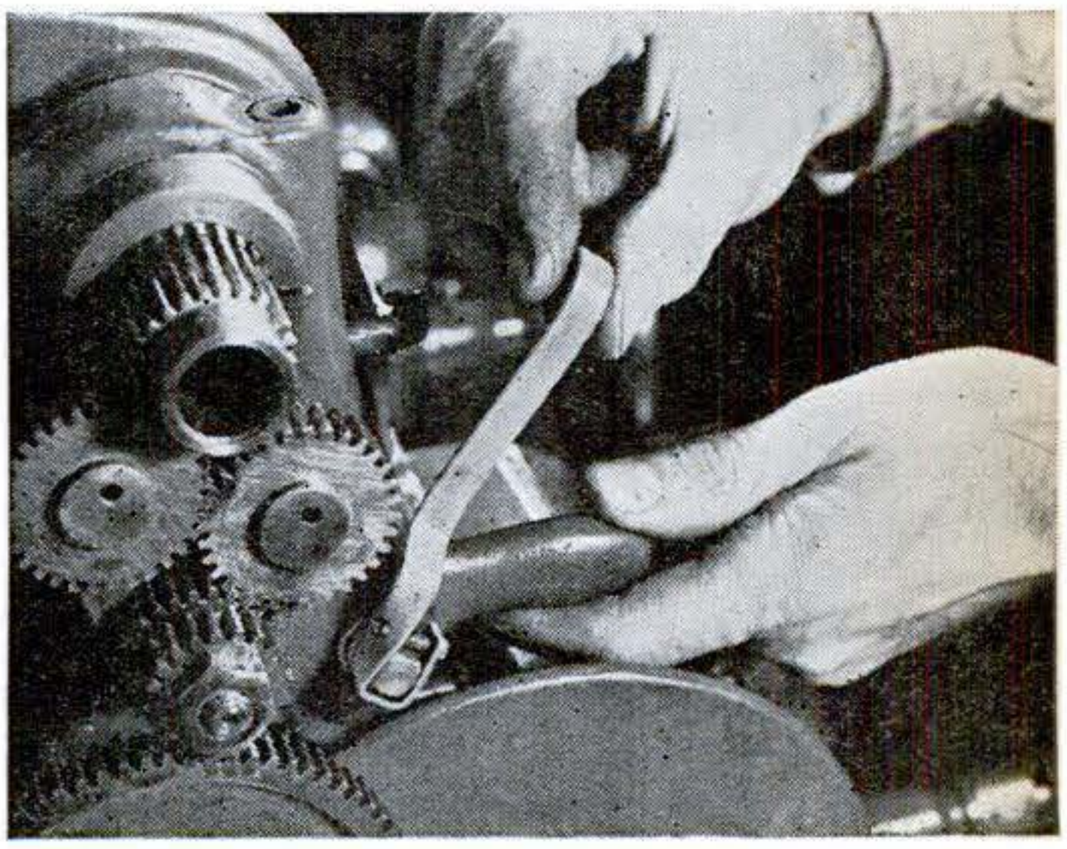


USE OF A PERMANENT "WRENCH" will help in changing a feed-reverse lever on a lathe equipped with a lock bolt to hold the lever in neutral or in the engaged position. Index marks in addition help avoid errors.

The wrench may be bent from strip steel with one end fitted around three sides of the bolthead and bound to it with a 6-32 bolt as shown at right below. To stiffen the piece where it is twisted 90 deg., and to provide more anchorage for the threads of the 6-32 bolt, the thickness may be built up there by brazing. The outboard end of the wrench is bent into a loop for a convenient grip, and the entire piece is bent as necessary to clear the gear guard and the feed-reverse lever. Be sure to bolt the wrench on the bolthead in such a position that the feed-reverse lever will move freely when it is raised and will be locked securely when it is depressed.

If index marks are painted on the feed-reverse lever and the headstock casting next to it, as shown at left below, you can tell at a glance whether the lever is in neutral or feed position. Paint in the lines with white lacquer or enamel.





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Animal Portraits
WITH A HOMEMADE FLASH RIG

By R. DeWitt Miller

ONE of the most fascinating branches of animal photography is "flash trapping." Causing animals to take their own pictures is a sure way of getting wild life in natural portraits. In spite of its high average of excellent results, the hobby is one of the least expensive.

You can build your flash-trapping rig for an outlay of less than $2. Any type of camera will serve—even an ordinary box camera. With the setup you can take intimate close-ups of wild animals at night and even "catch" stray dogs that overturn your garbage can or a prowler tampering with your door.

Besides any camera that you have on hand, you will need a number of flash bulbs, a mousetrap, two size D flashlight batteries, an attachment plug, a receptacle for it, a socket for the flash bulb, 10′ of lamp cord, some wire, friction tape, a piece of string, a screw eye, a No. 2 tin can, two bolts and wing nuts, some scrap lumber, nails, screws, and a wind-up alarm clock. The clock is not counted in the cost. You can use the one you have if you can spare it on the nights you want to take pictures.

The mousetrap is the trigger mechanism that sets off the flash bulb when the animal nibbles on bait. It is mounted on a short length of board along with the two flashlight batteries and the electric receptacle. Tape the cells to the board and connect them in series between the receptacle and the mousetrap spring. Then solder a lead from the other side of the receptacle to a screw driven in the mousetrap at a point where

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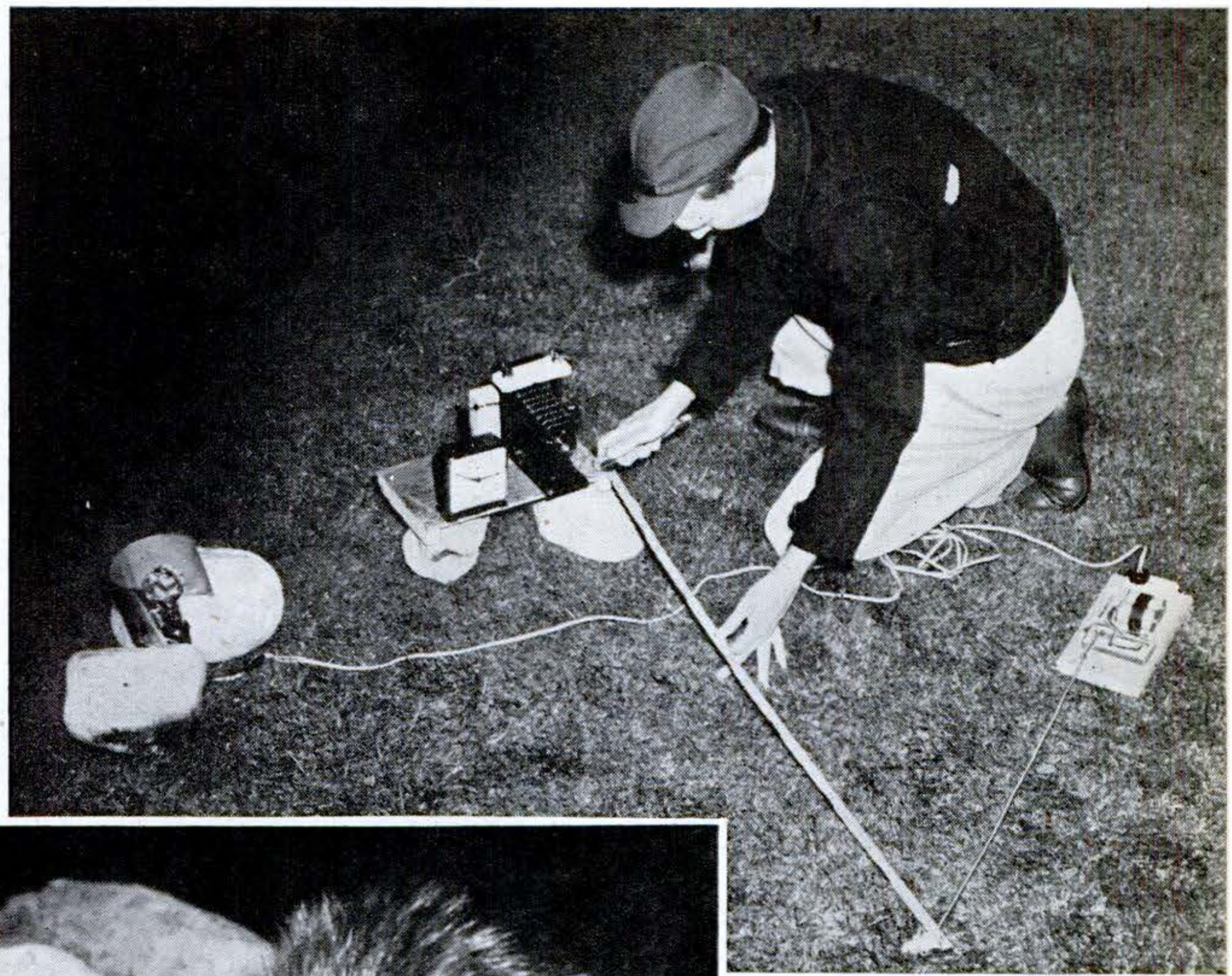
the arm will make firm contact with it when the trap is sprung.

A length of string tied to the trigger mechanism and run through a screw eye in the corner of the board is tied to a small piece of bread or meat for bait. When the animal pulls at the bait in an attempt to carry it away, the jerk on the string will spring the trap and the bar will hit the wired screw to complete the electric circuit and fire the flash bulb.

The flash bulb is, of course, screwed in the socket at the end of the lamp cord, which is plugged into the receptacle on the battery and trigger board. An efficient reflector for it can be made from a No. 2 tin can. The top should be removed completely from the can and the can slit down its entire length with tin snips. Cut around the bottom both ways from the lengthwise cut until only about 1″ of the metal is left attached. Make two cuts slanting inward halfway through the bottom and bend back the flap thus formed. This provides a notch in which the lamp socket is fitted. A little bending with pliers will hold it firmly.

Place the camera on a rock or tripod, focus it on the bait, and arrange the flash bulb and reflector 4′ or 5′ from the bait. In a dark corner of woods, it is possible to set the



Focusing the camera on the bait. The distance is measured to assure good focus. The cord on the bait is tied to the trigger of a mousetrap that closes the flash-lamp circuit when sprung. Then the photographer opens the shutter and retires.

When an animal, such as this ferret, takes the bait it also takes its own picture. The rocks are arranged to force a head-on approach.

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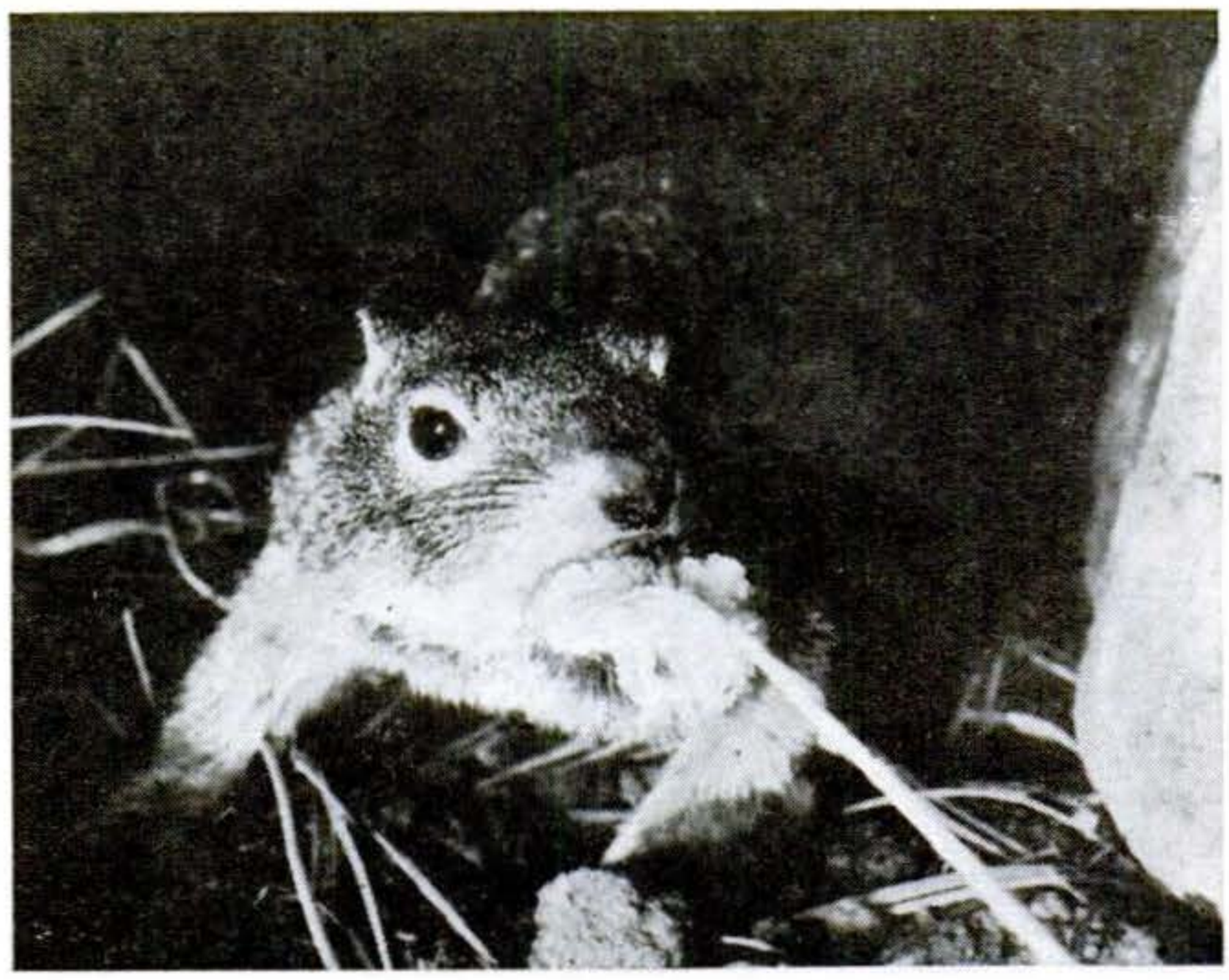
apart when the alarm clock is wanted for its original purpose.

Mount the clock on a short board with clamps or with screws through two holes drilled in the base if it flares sufficiently. Then mount the camera near it and facing the same way. This can be done with two bolts of proper length put through the board and a top block. The wing nuts will clamp it rigidly in place.

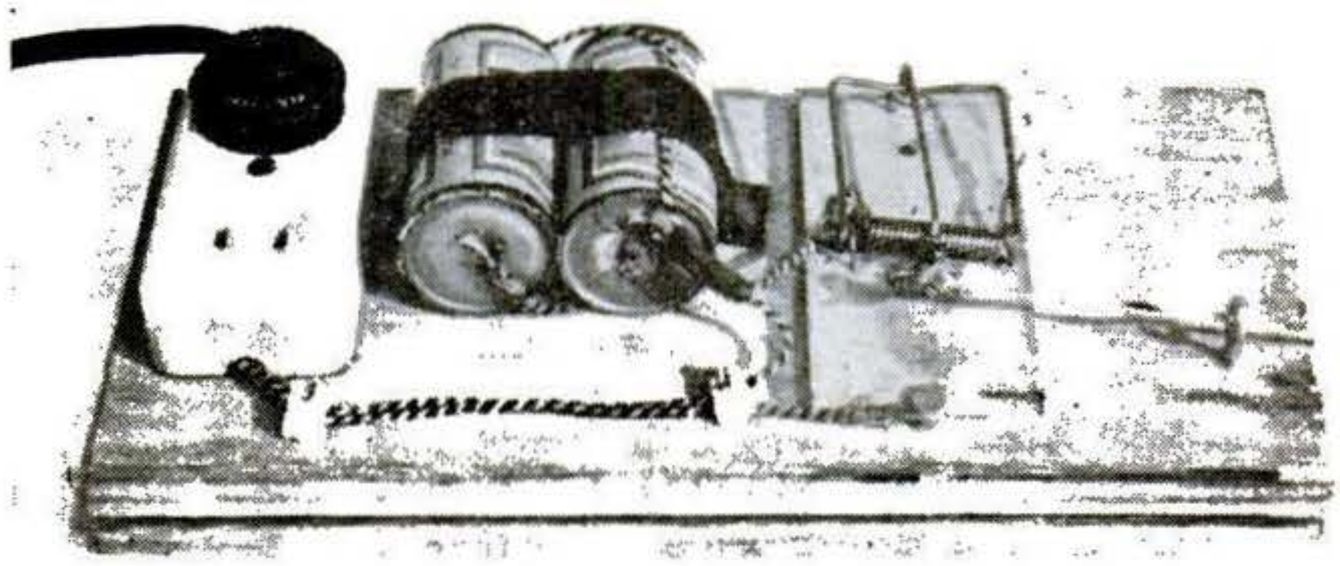
If your camera has a cable release, attach it with a staple to an upright mounted on the board near the alarm clock. The shutter on "time," open it, and go away to await developments. Unless there is very bright moonlight or a source of artificial light within range of the camera, the film won't be exposed noticeably until the flash goes off. You must, of course, stick around to be sure to close the shutter before daylight so the film won't be fogged and your picture spoiled.

If you would rather go home and enjoy a good night's sleep, you can use the alarm clock to close the shutter. It will work on either a folding or box camera equipped with a "bulb" setting for the shutter, that is, a setting at which the shutter is open when the cable plunger or the box lever is depressed and is closed again when it is released. You open the shutter as before, and the clock closes it at the time set for the alarm, an hour or so before the first light of dawn.

To use the clock, first attach a strip of light metal to the winding key of the alarm. The strip should be about ½" by 6" and reasonably stiff. If two small holes are drilled through the strip and the wings of the alarm key, they can be joined with two bolts and easily taken



Here a gray squirrel is "flash-trapped" on film as it nibbles bait. The outfit can be set up to identify prowlers, such as the dog nosing the cover off the garbage can at the top of this page.



This is the battery that sets off the flash. The cells are in series in a circuit with the flash bulb and the spring-mousetrap "switch."

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plunger should protrude beyond the upright. Wind the alarm key, bolt on the metal strip, and set the camera shutter on "bulb." Then bend the metal strip so it will press against the cable-release plunger with enough force to hold the shutter open. When the alarm goes off, the key will turn as the spring unwinds and move the metal strip away from the plunger, allowing it to spring out and close the shutter.

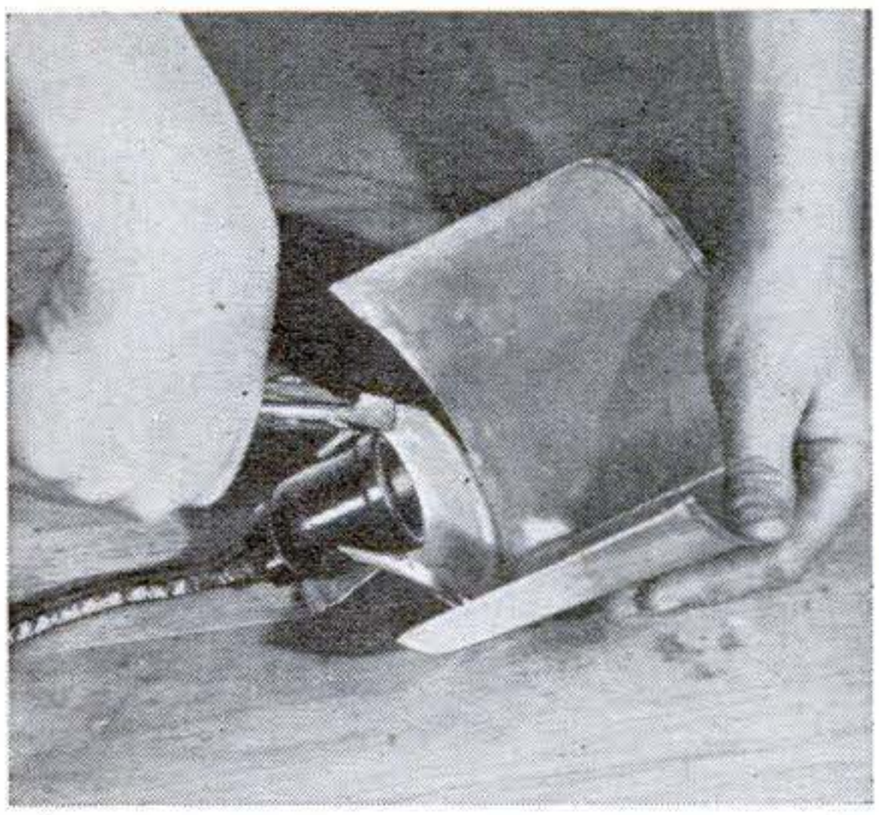
No upright is needed for a box camera. The metal strip should be just long enough to reach the shutter lever and hold it down when the shutter is set for "bulb." A right-angle screw hook may be inserted in the base stock where it will stop the metal strip after the shutter has been closed.

Some experimenting may be necessary with the camera to be used in order to perfect operation of the release. The arrangement is so simple, however, that once the metal strip is adjusted to hold the plunger down no difficulty should be experienced.

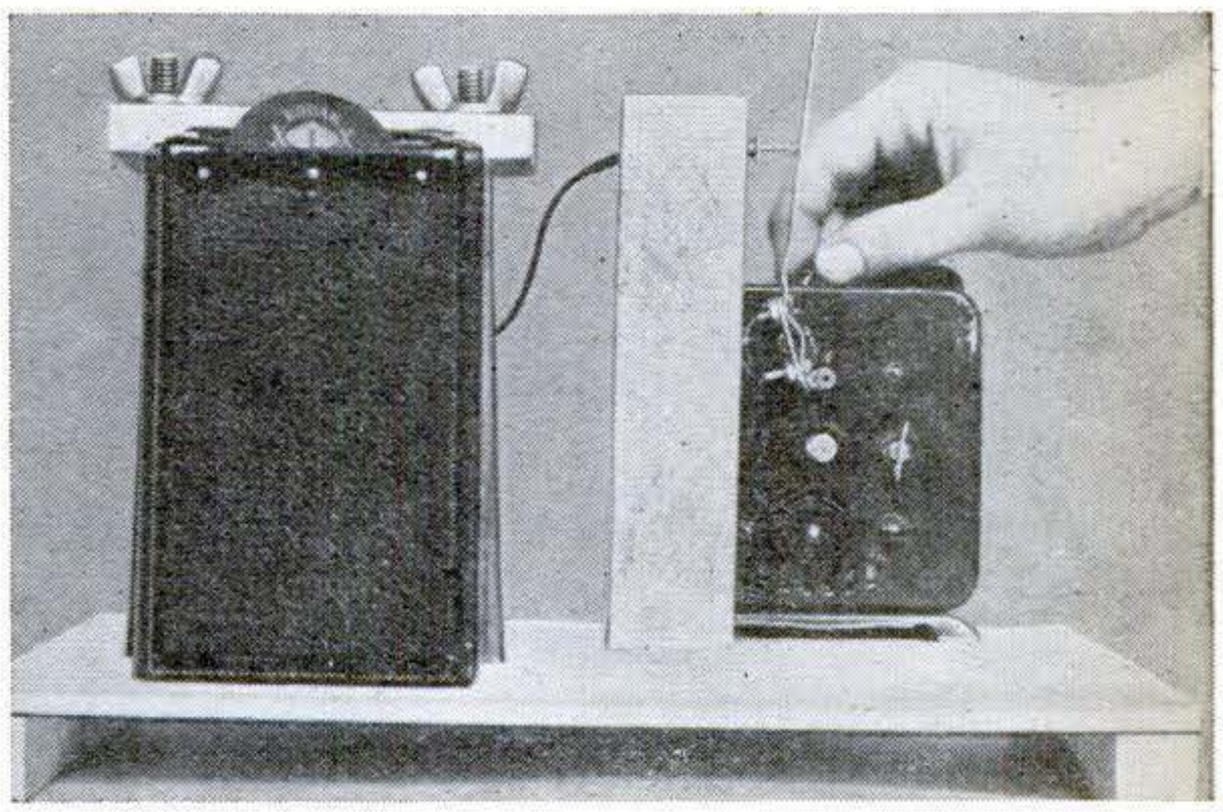
In setting up the equipment, place the bait not more than 5′ from the camera unless you are "trapping" large game such as deer. Measure the distance from bait to camera and, if your camera has a footage scale, set it for the proper distance. Don't worry about stopping action. The animal will need a fraction of a second to start moving, and the duration of the flash will be so brief that a shot will seldom be spoiled.

Any ordinary flash bulb will be satisfactory, but you may prefer one of medium size, say a No. 22. Use fast film.

In most cases it may be found the best plan to arrange the bait in such a way that the animal will have to approach the camera head on. This can be accomplished by strategic placement, utilizing rocks and brush to make a head-on approach the simplest for the animal. Head-on shots of animals are usually the most dramatic.

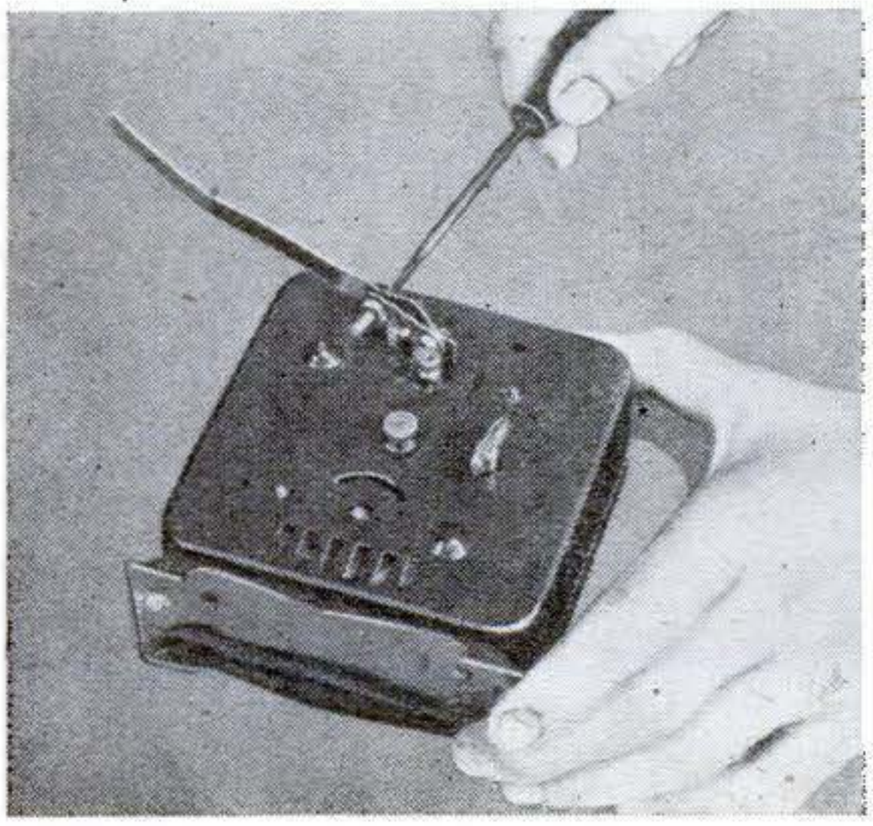


A split tin can makes a good reflector for the flash bulb. The bottom is notched and bent to hold the socket securely.

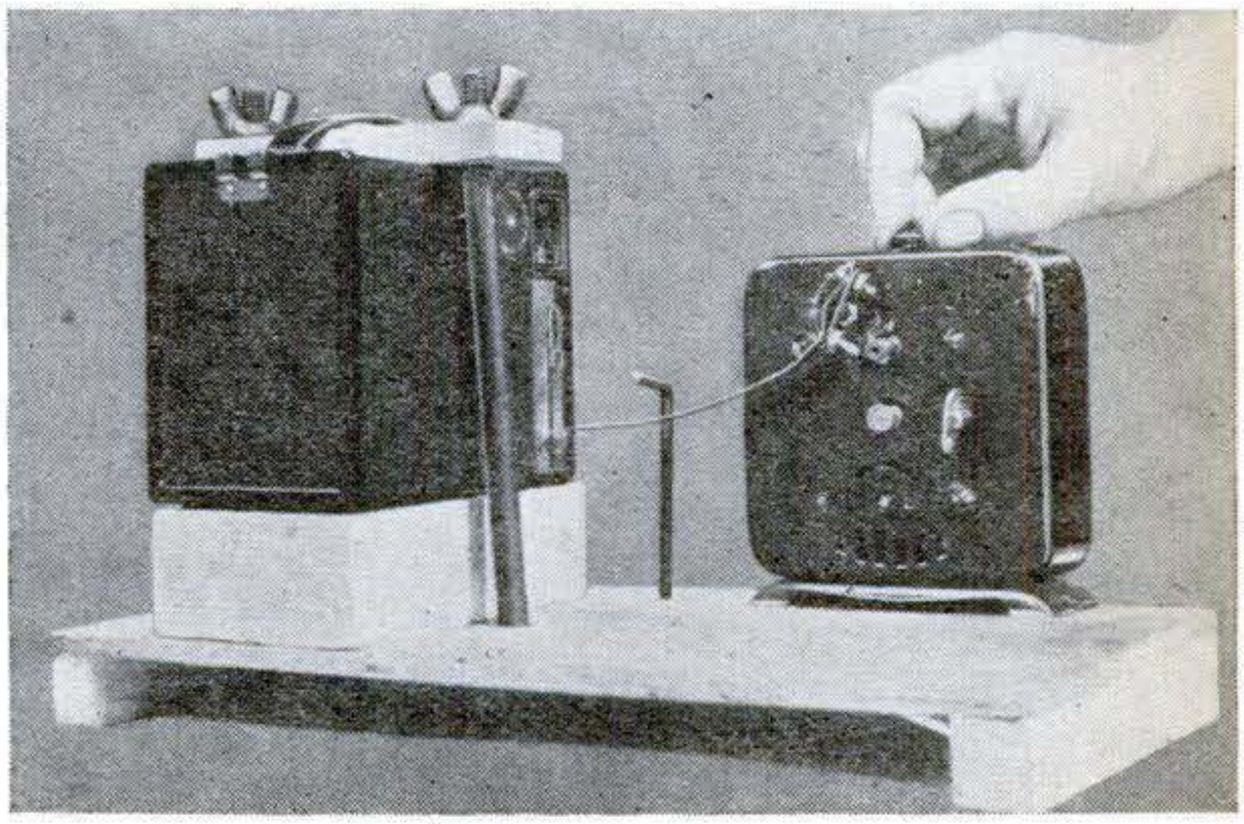


This is the setup from the rear for a folding camera. The cable release is supported on the upright, and the metal strip presses the plunger in to hold the shutter open.

Bolted to an alarm-clock winding key, a metal strip operates the camera shutter.



And here is the arrangement for a box camera. The lever is freed and the shutter is closed when the alarm goes off.



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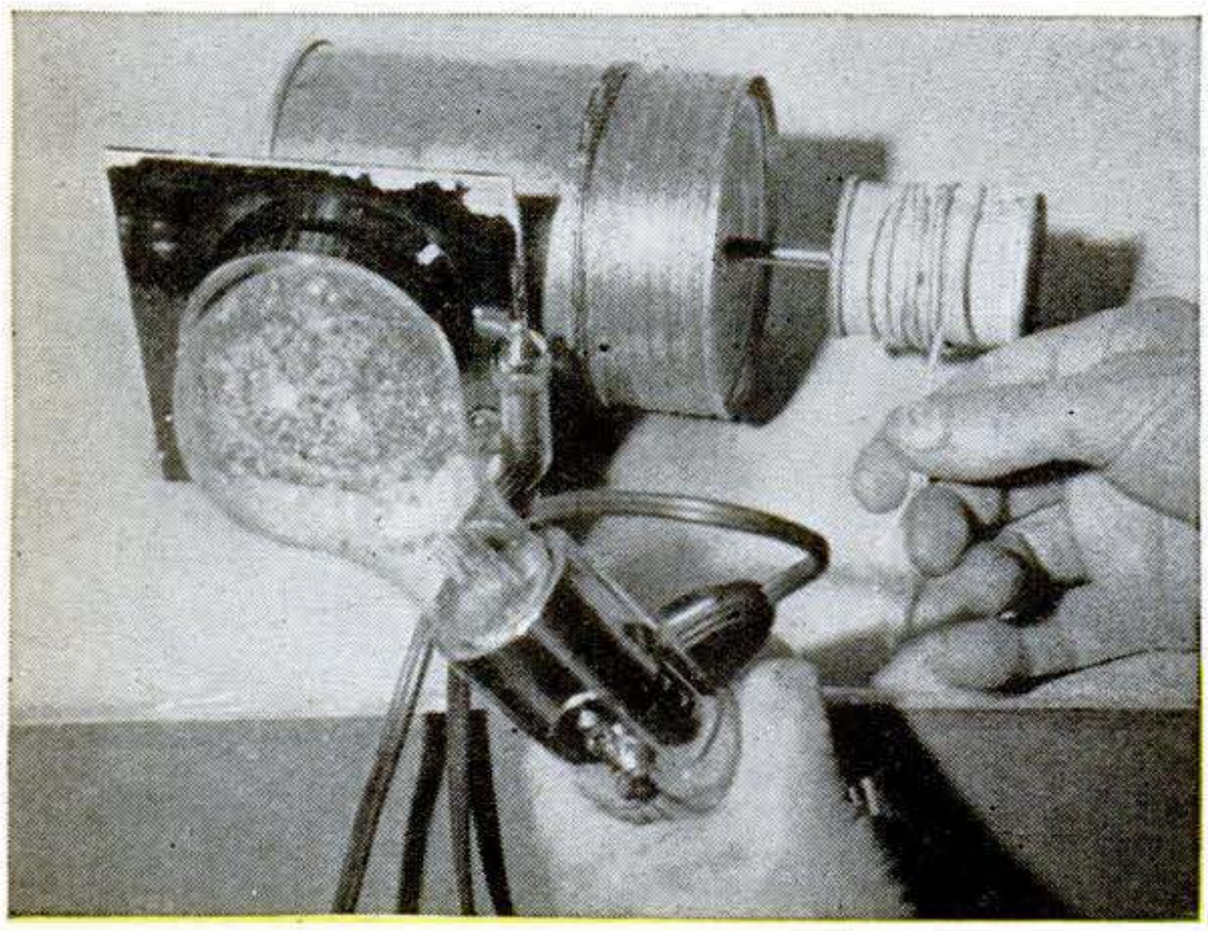
SPINNING CAN TESTS SYNCHRONIZER

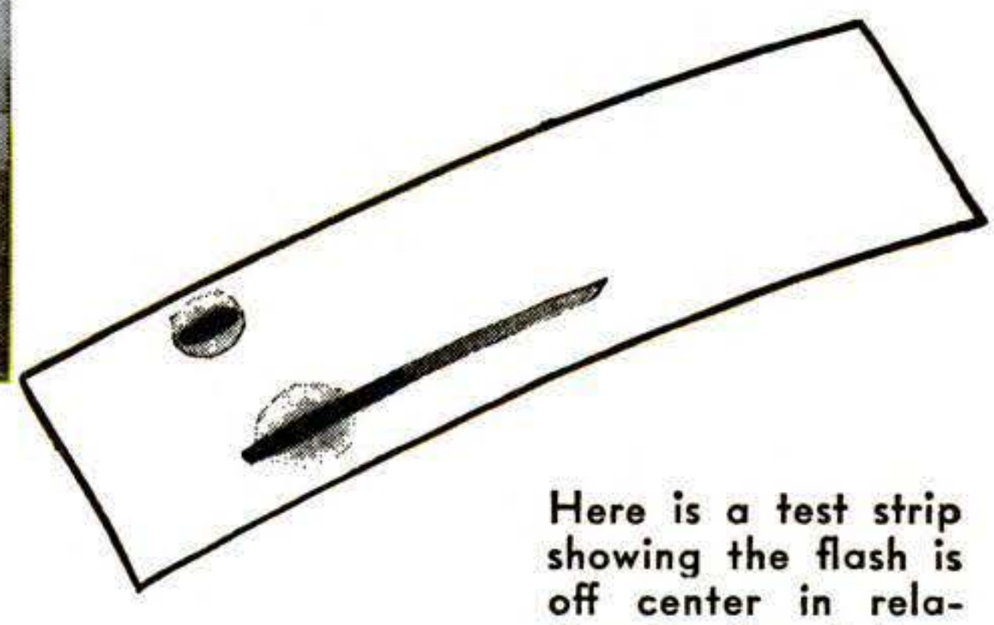
THERE are several ways you might check the performance of a flash synchronizer on a camera, but a simple apparatus assembled from two tin cans, a short length of ¼" shaft, and a wooden spool provides one of the quickest and most accurate methods.

One of the cans should have a slip-on or screw-on lid. The second serves as a drum on which a test strip of enlarging paper revolves. Hence, it must be just small enough to fit inside the larger can and turn freely after the paper is mounted. Hex nuts soldered on the shaft against each end of the small can provide a secure joint. The holes in the ends of both cans must be carefully centered so the drum will track accurately. Two small holes in the side of the larger can are the means of checking the synchronization, one admitting light that passes through the lens and one admitting direct light from the flashbulb. These must be parallel with the drum axis.

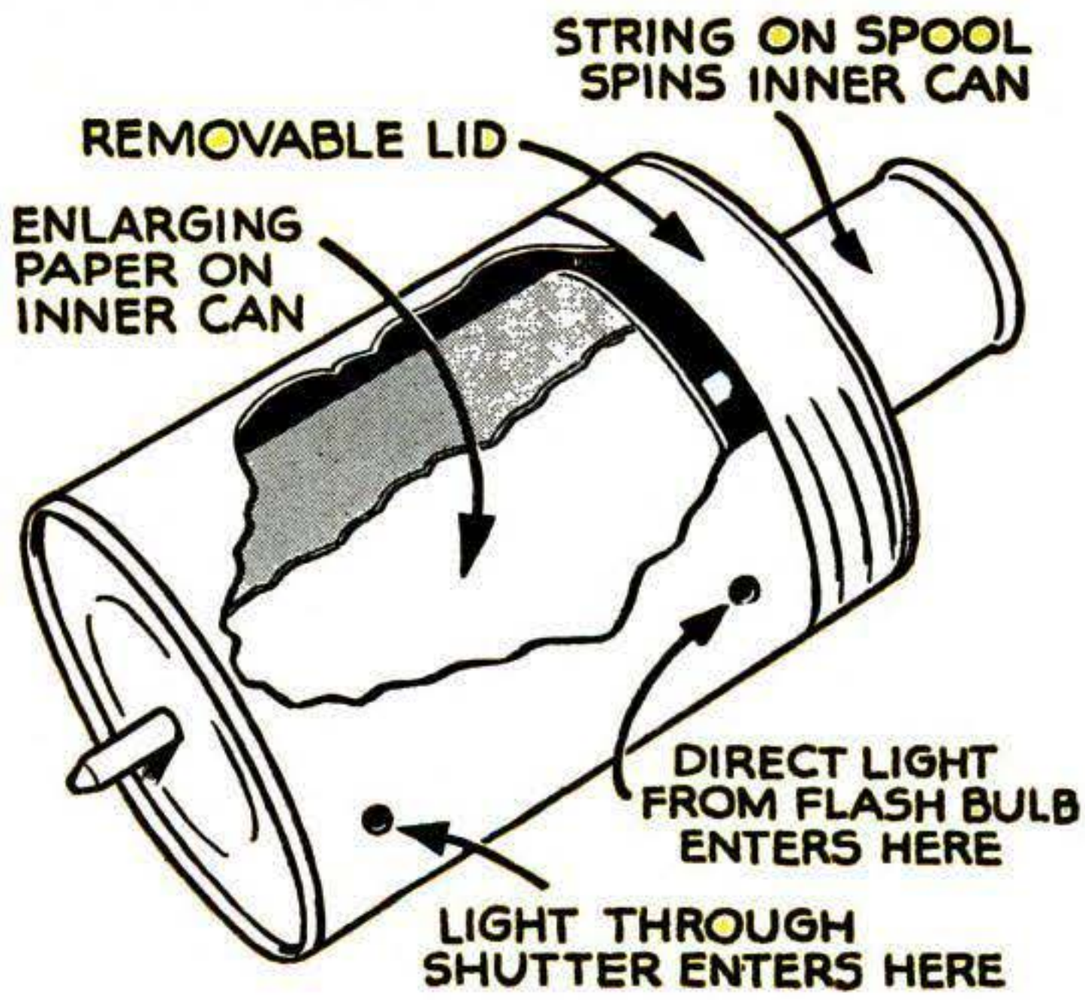
A spool should be pressed on the outer end of the shaft. Cut a piece of enlarging paper to width in the darkroom, tape it on the inside cylinder, insert the cylinder in the large can, and screw or press the lid in place. Wrap a length of cord around the spool, putting the end under so it will pull free. Set the camera or lens board in front of one hole with the synchronizer connected, spin the drum by giving the cord a quick pull, and flash the gun.

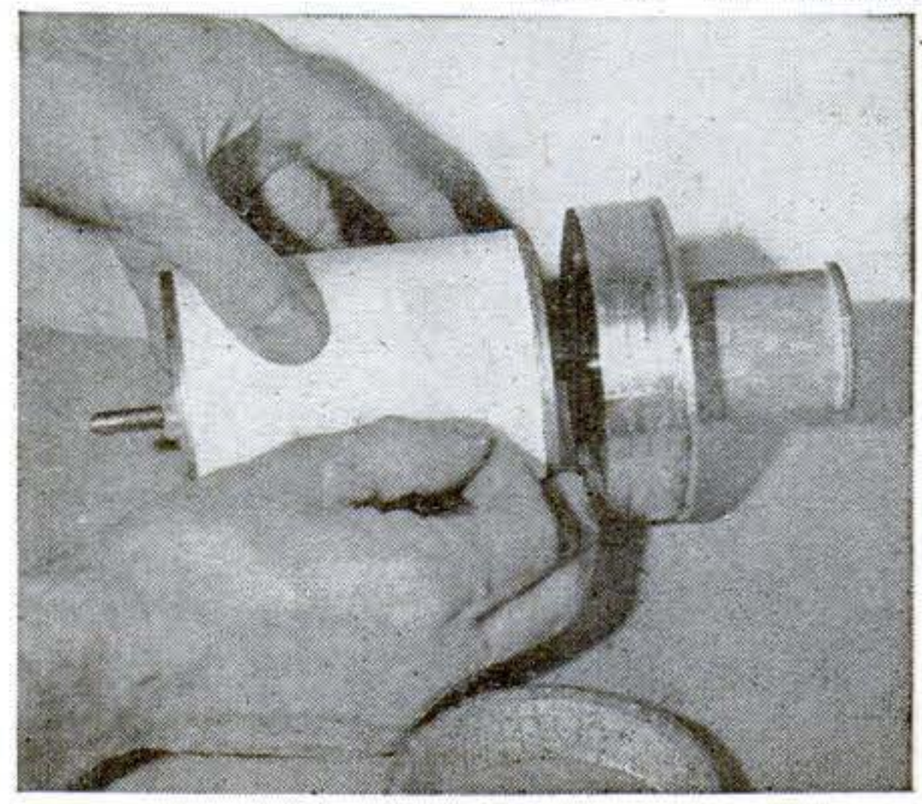
When you remove and develop the paper, you will find two black streaks, a short one that was made by light going through the shutter and a longer one caused by direct light from the bulb. The density and width of the latter will indicate when the peak of light intensity occurs in relation to the shutter opening. If the synchronization is off, the peak will occur too early or too late with respect to the shutter action. To know which, you must of course remember the direction of drum rotation.—CHARLES T. PEARSON.





Here is a test strip showing the flash is off center in relation to the shutter.





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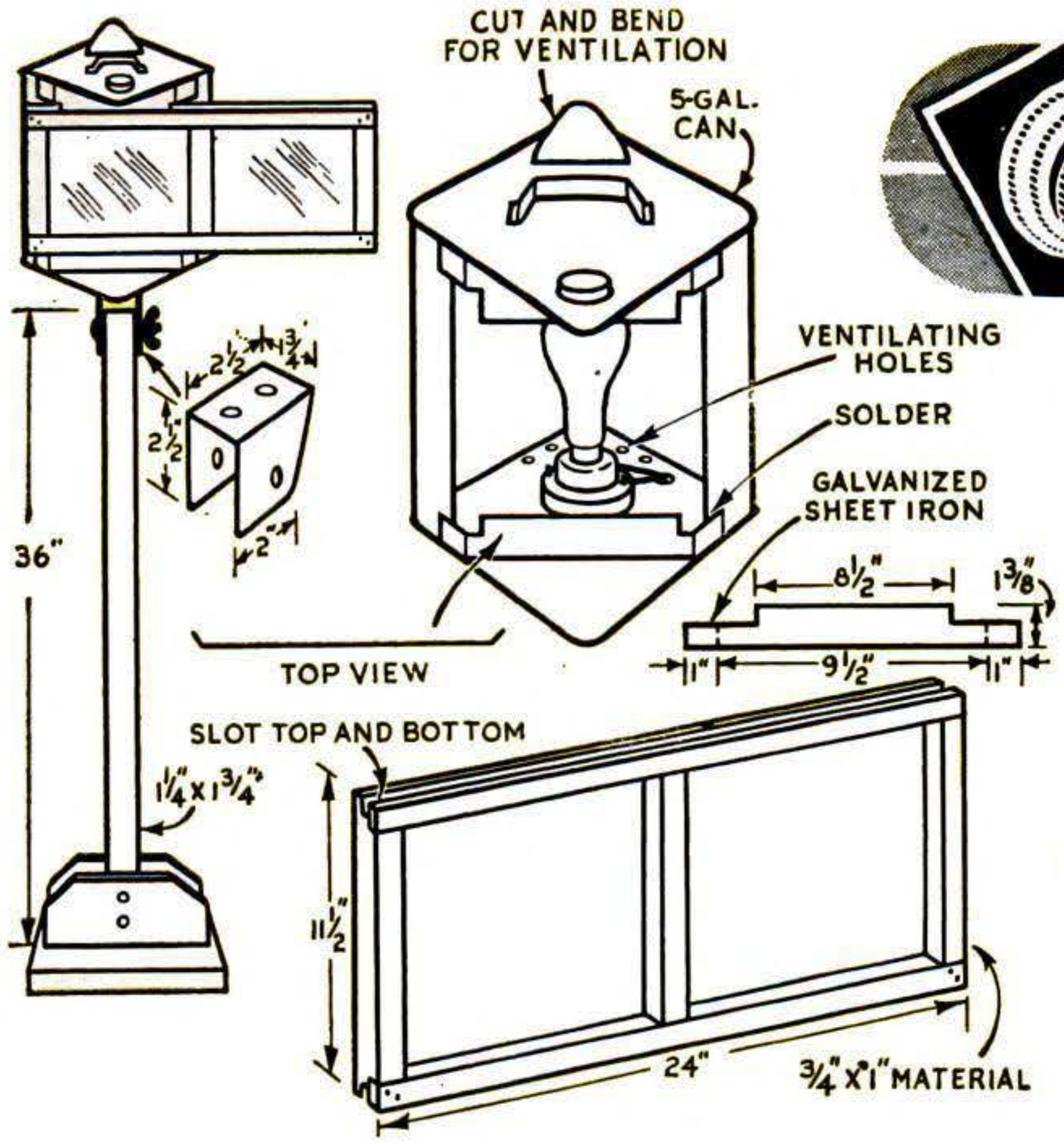
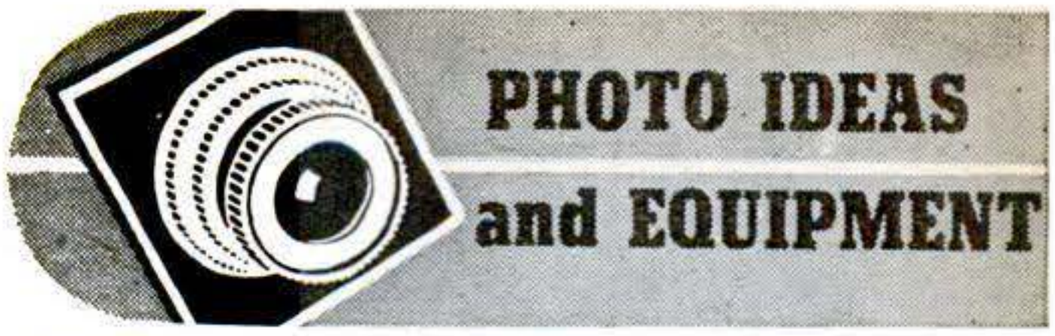
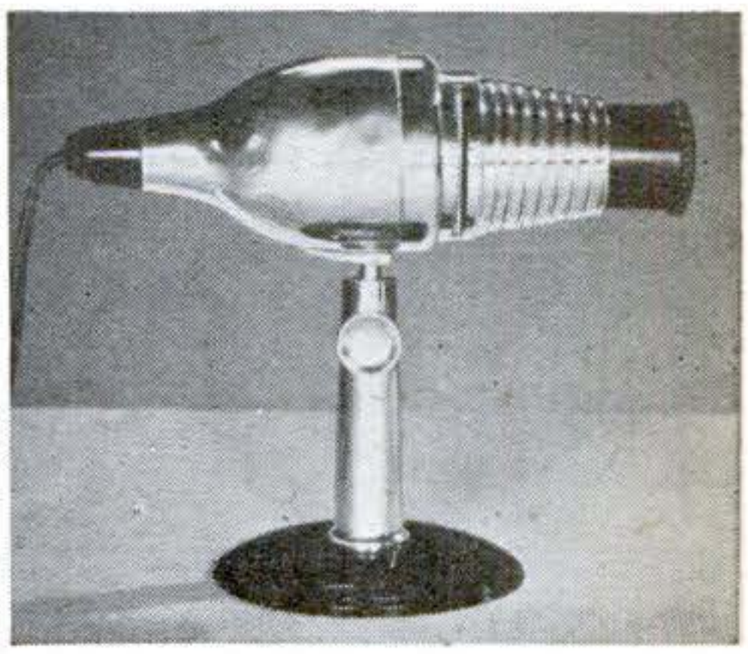


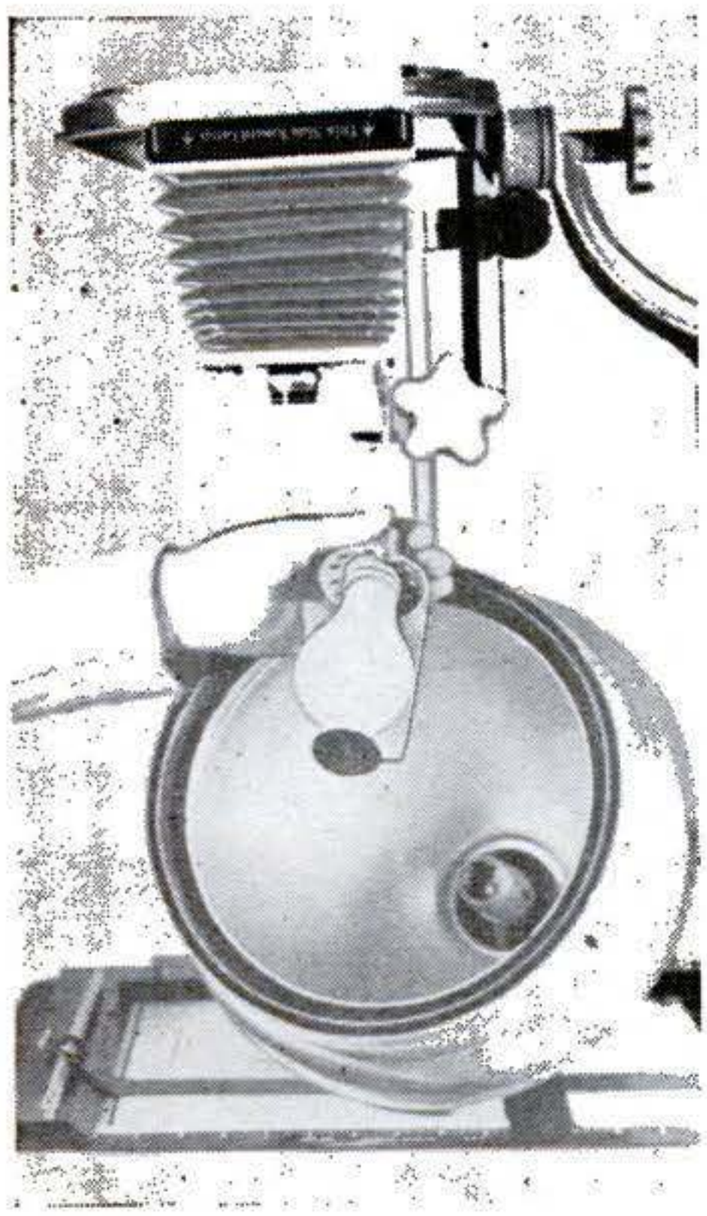


MANY PHOTO USES can be found for the new gadget below, known as the Apex Multiscope. Made by the Apex Tool and Machine Company, Glendale, Calif., it serves as a viewer, projector, table tripod with a 90-degree tilt, a tilting head for any standard tripod, or, if you wish, a hand holder for your camera.

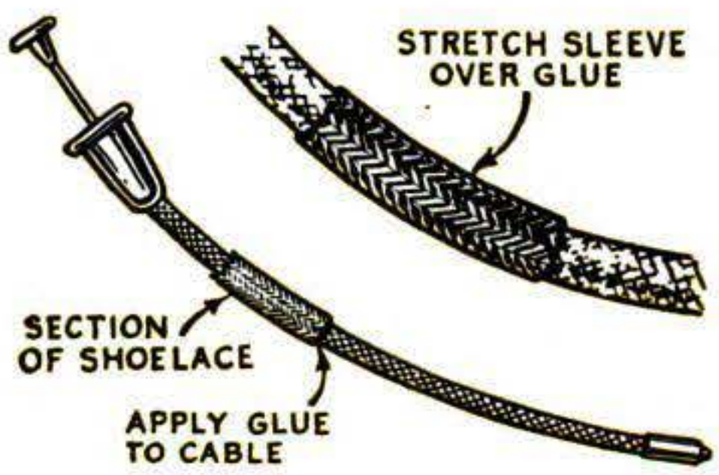
The Multiscope is manufactured of light metal alloys. Instead of the usual projection lamp, it uses an ordinary bulb.



OILCAN FLOODLIGHT. Cut away most of two sides of a 5-gal. rectangular oilcan, bend in the vertical edges to add strength, and file the top and bottom edges smooth. If the inside of the can is not shiny enough to make an adequate reflector, paint it with white enamel. Cut guides for the slide from galvanized sheet iron and solder them in place. Different colored sheets of gelatin can be taped to the slide. For best results, be careful not to stretch them too tightly.—CLARENCE A. TAYLOR.



HOT SPOTS in diffusion enlargers may be eliminated by suspending a baffle beneath the bulb. The baffle, a disk of tin plate about the size of a quarter, may be installed by cutting and bending the wire uprights of a metal lampshade holder of the screw-on type, soldering the baffle to the wire as indicated in the photo and then screwing the holder on the enlarger lamp socket. The bulb should be adjusted up or down to find the new critical point of light concentration that gives even distribution over the picture area. Open the diaphragm fully for this.—E. PETER SMITH.



BLACK SHOELACES provide material for an almost invisible repair job on a cable release that has become worn. Cut off a short section of the lace, apply glue to the frayed part of the cable, and slip on and stretch the lace so that it adheres. Work the plunger several times before the glue hardens in case some is inside.

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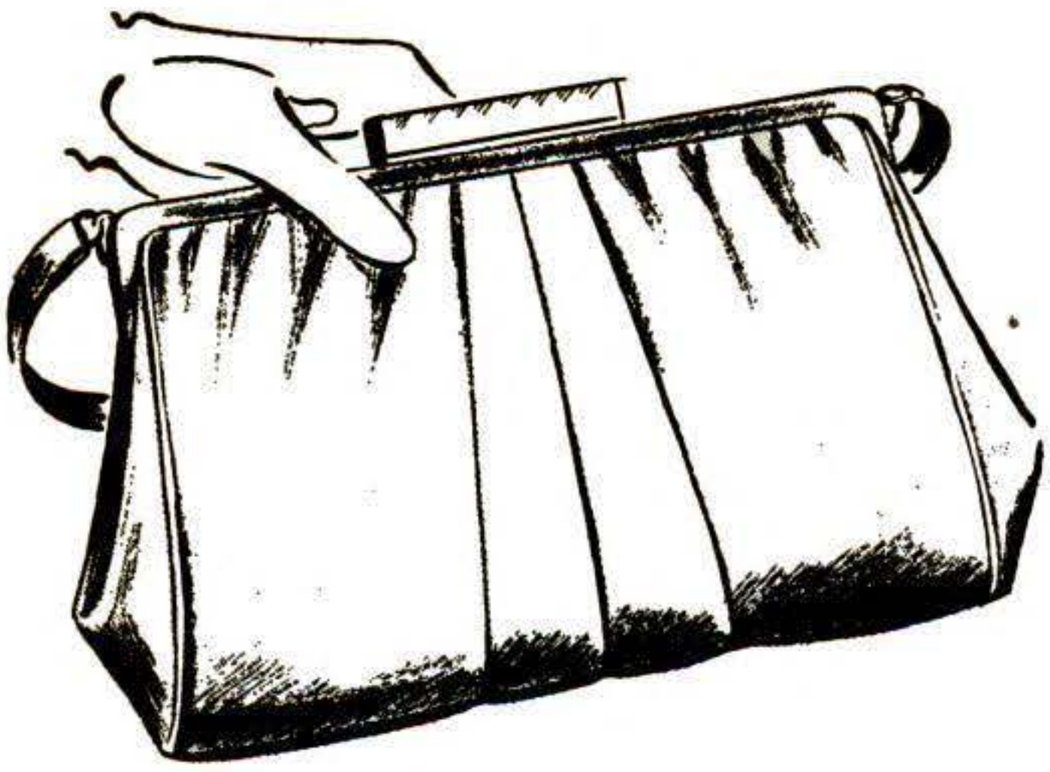
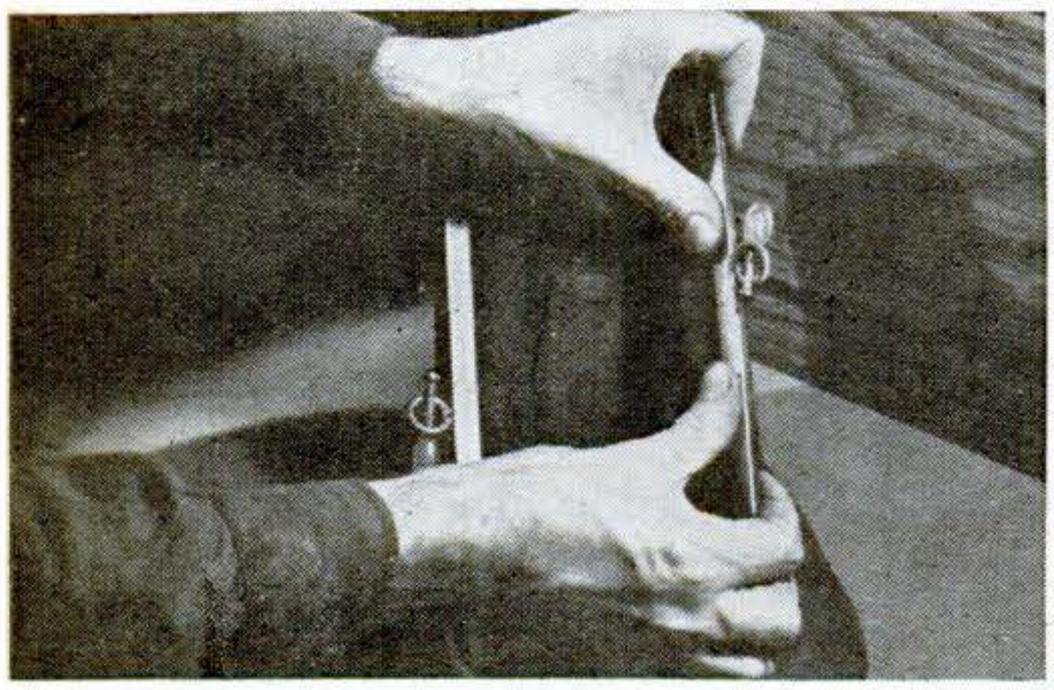
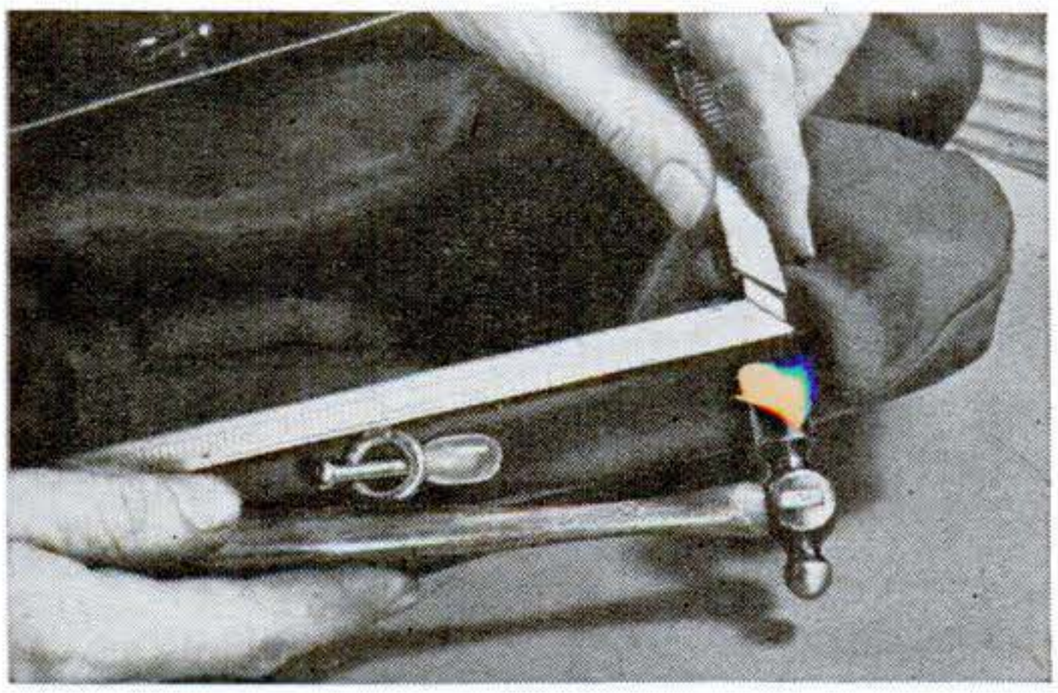


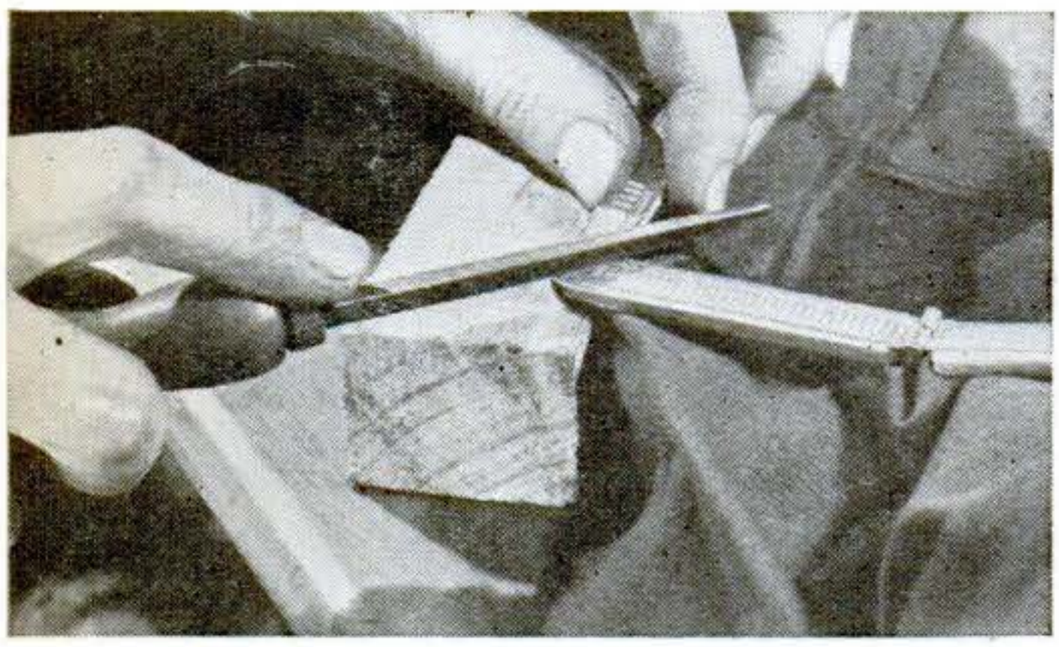
REPAIRING WOMEN'S HANDBAGS

AMERICAN women throw away enough handbags every year to hold a sizable part of the national debt—and then spend almost that much money buying new ones. Yet the shabby leather, broken frames, and loose catches that afflict most discarded purses can easily be fixed and the bags rejuvenated for many more years of going-to-market.

A frequent source of complaint is the catch that doesn't catch. This difficulty can often be traced to loose hinges, which, if made of metal, are readily tightened with pliers or hammer as illustrated in Figs. 1, 2,







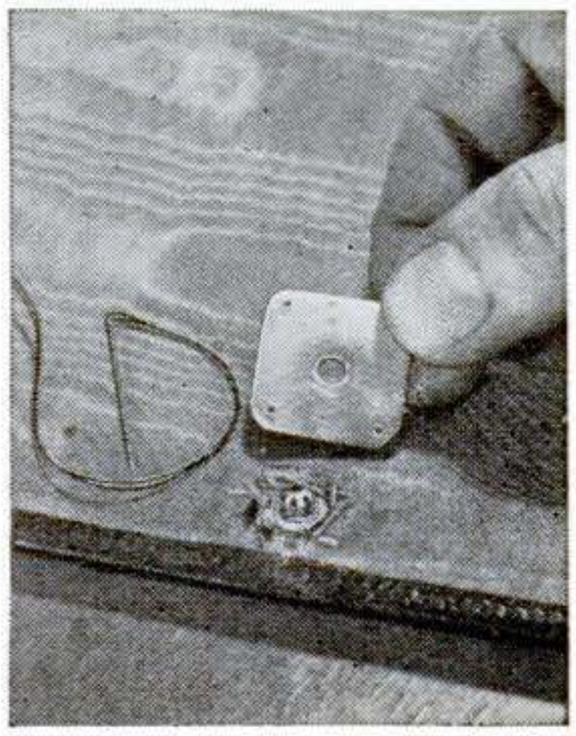
If the bag suffers from end gap—the center closes but the ends don't—gently bend the frame until it is slightly concave toward the inside. The photo at the upper left shows how it is done.

The corners of metal frames, sometimes held merely by crimping, come apart easily. An insert made of L-shaped sheet metal can be slipped into two sides to strengthen the joint (photo above, right).

For additional reinforcement at the corners, make a V-shaped groove with a triangular file and fill with solder. The repair will be inconspicuous if the excess solder is smoothed off when cool (left).

If handbag fabric pulls away from a wood frame, clean out the slot carefully, and put in a little glue or household cement. Then press the fabric back into the slot with a screwdriver. Keep glue away from the material.

Snap fasteners torn loose from the lining can be held in place with a plate of thin sheet metal. Punch a hole in the center big enough to admit the male half of the fastener, and put small holes around the edge. Slipped over the catch, the plate is sewn to the lining through the holes.



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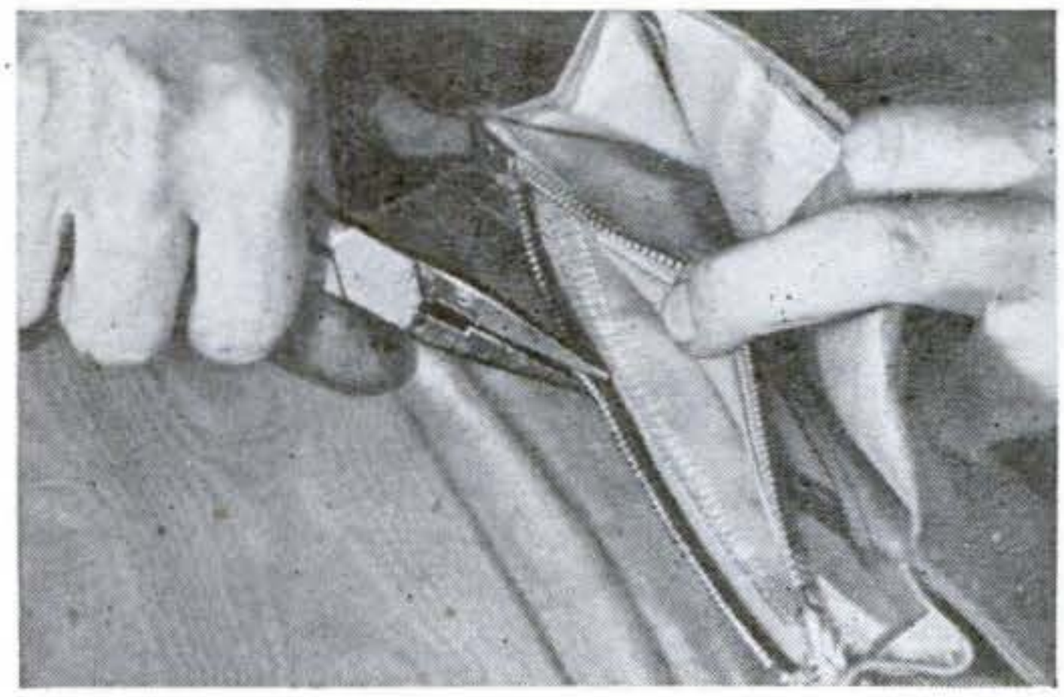
and 3. A nonrigid frame may also cause trouble; reinforcing corner joints as shown in two pictures on the facing page is one remedy. Sometimes the catch itself is loose. Tighten it by soldering, riveting, or gluing. Snap fasteners can be made to hold by tapping with a hammer (Fig. 4).

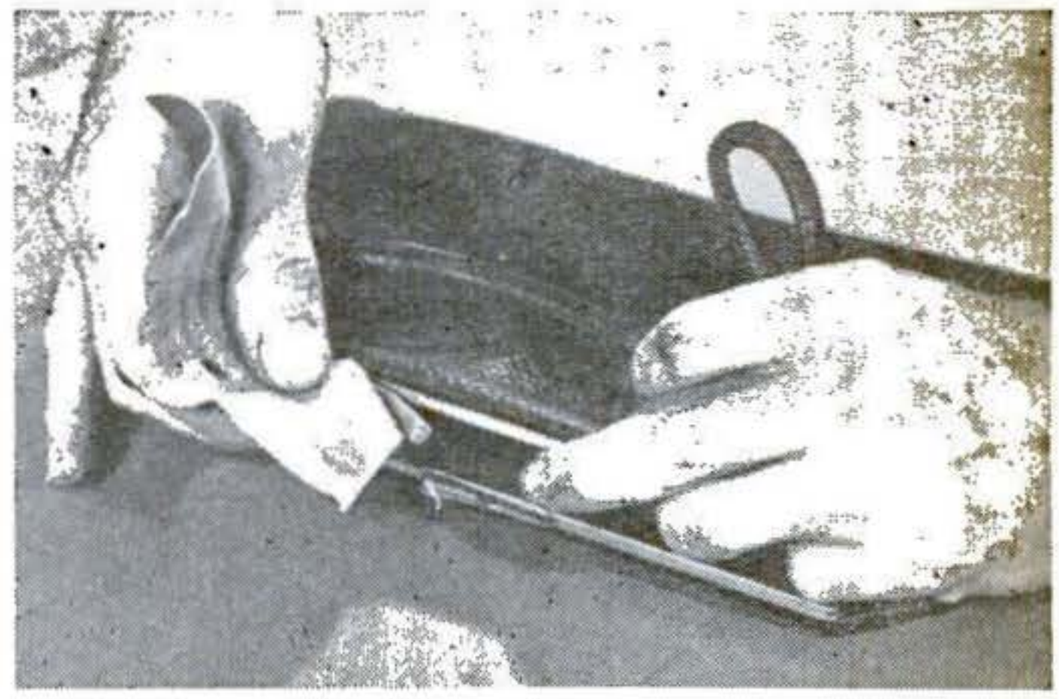
Another common trouble is a broken or cracked frame. For plastic frames, try cement to suit the particular plastic involved (acetone or movie-film cement frequently works). Small reinforcing strips can also be mortised in over a break and held with screws or rivets (Fig. 5). Placed on the inside of the frame, these strips will not be noticed. Tiny dowels, made by cutting brads to length, also help fix plastic (Fig. 6).

Several ways to repair metal frames are shown in the photographs on the opposite page. If the bag has pulled loose from its frame, pry the frame apart slightly, push the edge of the bag and the lining back in place, and press the frame closed again with pliers (Fig. 7).

Wood frames can be fixed by any one of the methods standard for small wood articles. Generally, refinishing will also be necessary. To produce a new-looking uniform sheen, apply French polish after touching up scratches with wood stain or water color. Moisten a cloth pad with orange shellac, add a bit of linseed oil by dipping your finger in the oil and touching the pad, and rub on the wood. Use a little at a time, rubbing until the tackiness is replaced by an even and attractive finish.—VERNON B. CASE.



Loose teeth on a slide fastener can be tightened by pinching them near the inner or base end. It is often simpler, however, to sew in a new fastener than to attempt to repair a defective or unreliable one.



If the finish on a metal frame is badly worn, rub with abrasive cloth until it is bright once more. Then cover with a coat of clear or colored lacquer to prevent the metal from tarnishing again.

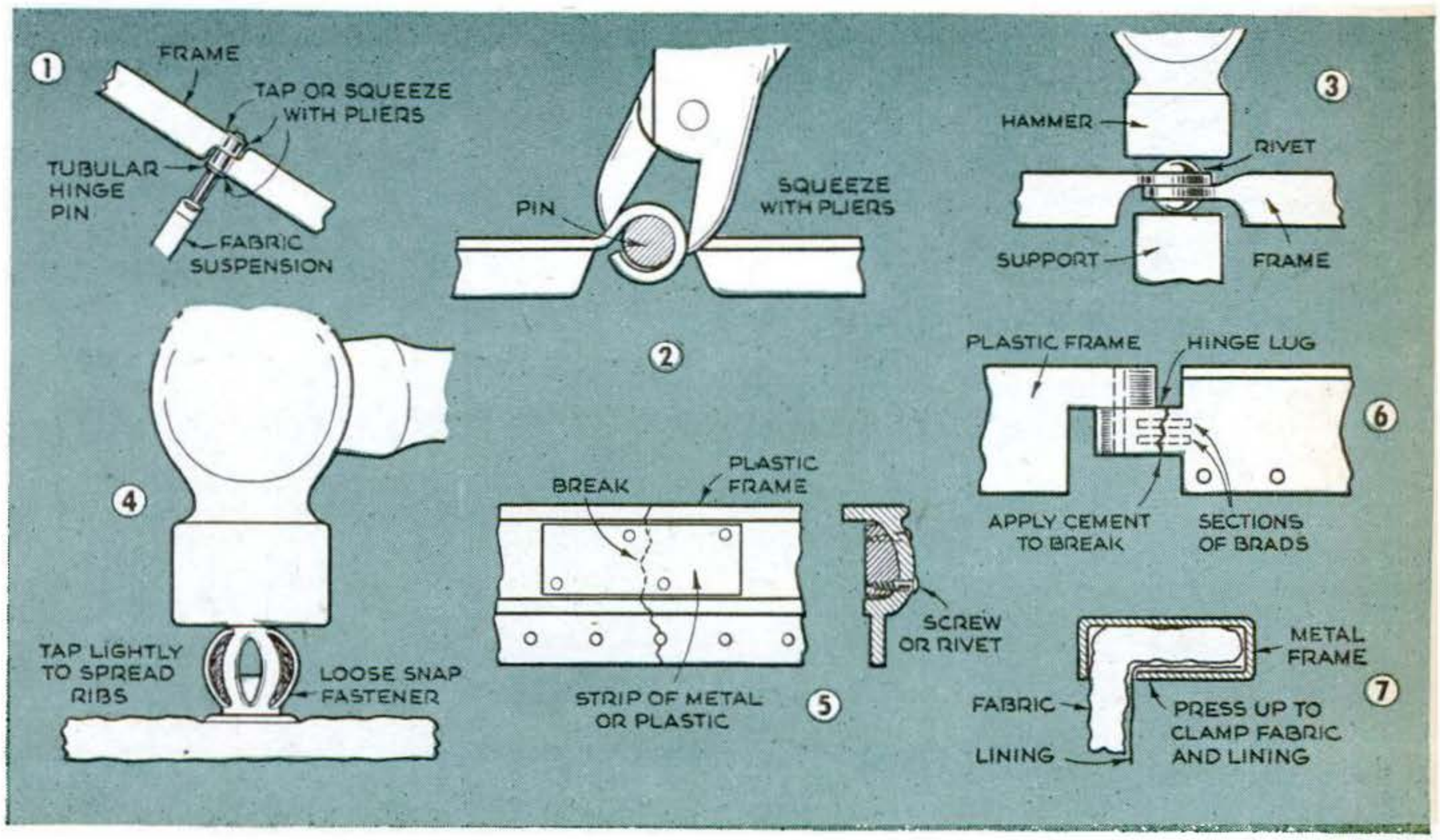


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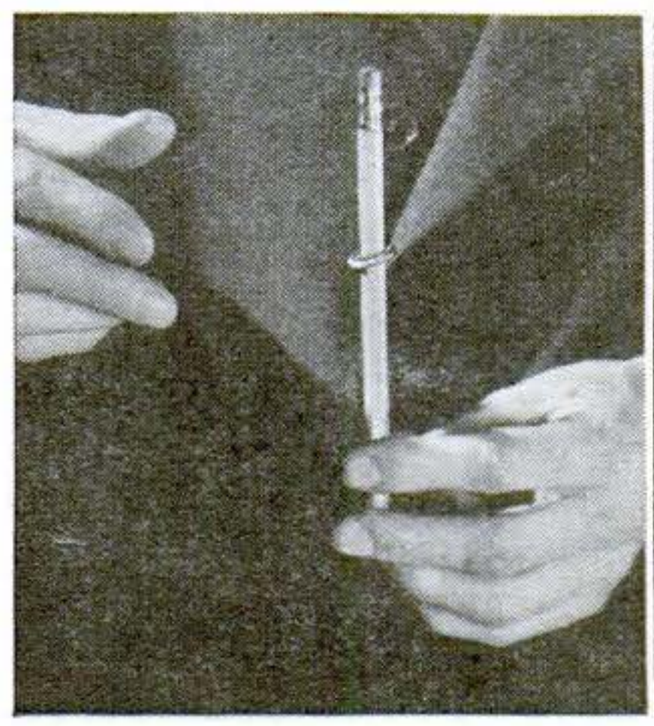
Table Magic

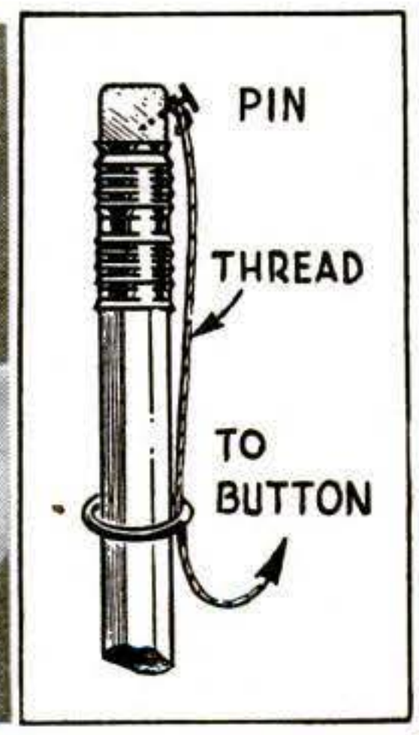
HYPNOTIZED CIGAR. No matter how your hand is moved, the above cigar stays mysteriously in place. And when it is pulled away, the audience will find nothing concealed in your hand. The trick depends on a short straight pin held between the fingers. Lay the cigar across your hand, impaling it on the pin. As the cigar is removed, open your fingers and let the pin drop to the floor.

A CARD STANDING ON END will add life to a dull bridge game. After your friends have failed to accomplish the trick, set the card on end, making elaborate balancing adjustments. But you must be fast enough with your fingers to palm the gimmick that acts as a support when returning the card to your audience for one more try. The support is a strip cut from a tin can and bent to the shape of an L. The bottom part is about ½″ long and the vertical side, which should lean back slightly, is 1″ in length.

EMPTYING A GLASS without disturbing paper strips crisscrossed on the top may make it appear that spooks are present in the darkened room. If they wish, spectators can hold your hands to insure fair play. You may call for ethereal assistance, but the trick actually depends only on a drinking straw, concealed in an inside pocket, fished out with the mouth, and slid into the glass. When the glass is empty, pull out the straw and replace it in your pocket. Some practice will be necessary to develop skill in manipulating the hidden straw in and out of pockets as well as in and out of the glass without touching those paper strips.

TRAINING RINGS TO JUMP up and down on a pencil is a simple matter if you know the magic words—or the trick. The trick requires a special pencil. In its eraser is stuck a pin holding one end of a short piece of thread. The other end of the thread is fastened to a coat button back of the middle of the pencil. When a small ring is slipped over the vertical pencil, it will fall or rise as you move the pencil closer or farther from that coat button. For a climax to your show, shift the pencil sharply away from you. The ring will be sent flying through the air.





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How to Carpet Your Stairs

By SIDNEY FENSTER

Proper laying of stairway runners gives maximum service. Then, if allowance is made initially, the carpet can be reversed when wear begins to show so the worn spots no longer fall on the nosings.

THERE is no trick to laying carpet runners—but a few kinks will assure you a professional look on your stairway and make the job quicker and easier. Allow ½ yard per tread and riser in ordering your runner plus an extra 6″ over-all for shrinkage when the carpet has to be taken up and cleaned. Buy ready-made pads for the treads or sufficient 32-oz. carpet lining for cutting up and double-padding each tread.

Clean and examine the stairs before going to work and remove nails that might cause snags or wear and tacks left from previous carpeting. Then nail down all loose or squeaky steps, driving three 8d. finishing nails through the tread into the riser.

Install the pads next, as in Fig. 1, leaving a space between the far end of each pad and riser and carrying the pad over the nosing. The padding should be about 4″ narrower than the runner (standard runners are 27″ wide) and centered between the sides of the steps, as shown in Fig. 2. Fasten them with No. 16 carpet tacks or blued lath nails, driving the front tacks under the nosing, not directly into it where they would wear through the carpet rapidly.

Begin laying the runner from the top of the stairway, first carpeting the hall or landing at the top. Chalk guide lines for the edges of the runner on each step, measuring them accurately so the runner won't go awry. Tack the end of the runner snugly against the edge of the hall carpet, and then roll the carpet down the stairs, pushing it loosely into each step.

Go back to the head of the stairs and tack the carpet in at the top step with four No. 16 tacks in each corner (Fig. 3), making sure to pull the carpet taut before tacking. Put two tacks into the riser first and follow with two in the tread. Then tack into each riser and tread in turn, working from top to bottom and keeping the edges aligned with the chalk guide lines.

When you reach the bottom riser, fold under the last 6″, as in Fig. 4, and tack all the way across the lower edge of the riser with tacks spaced about 3″ apart. Then go back to the top step, tack across the riser there, as indicated in Fig. 5, and proceed down, tacking across the lower or "inside" corner of each riser. This will stretch the carpet tight and keep it from "riding" on the steps. Put no tacks into the carpet under

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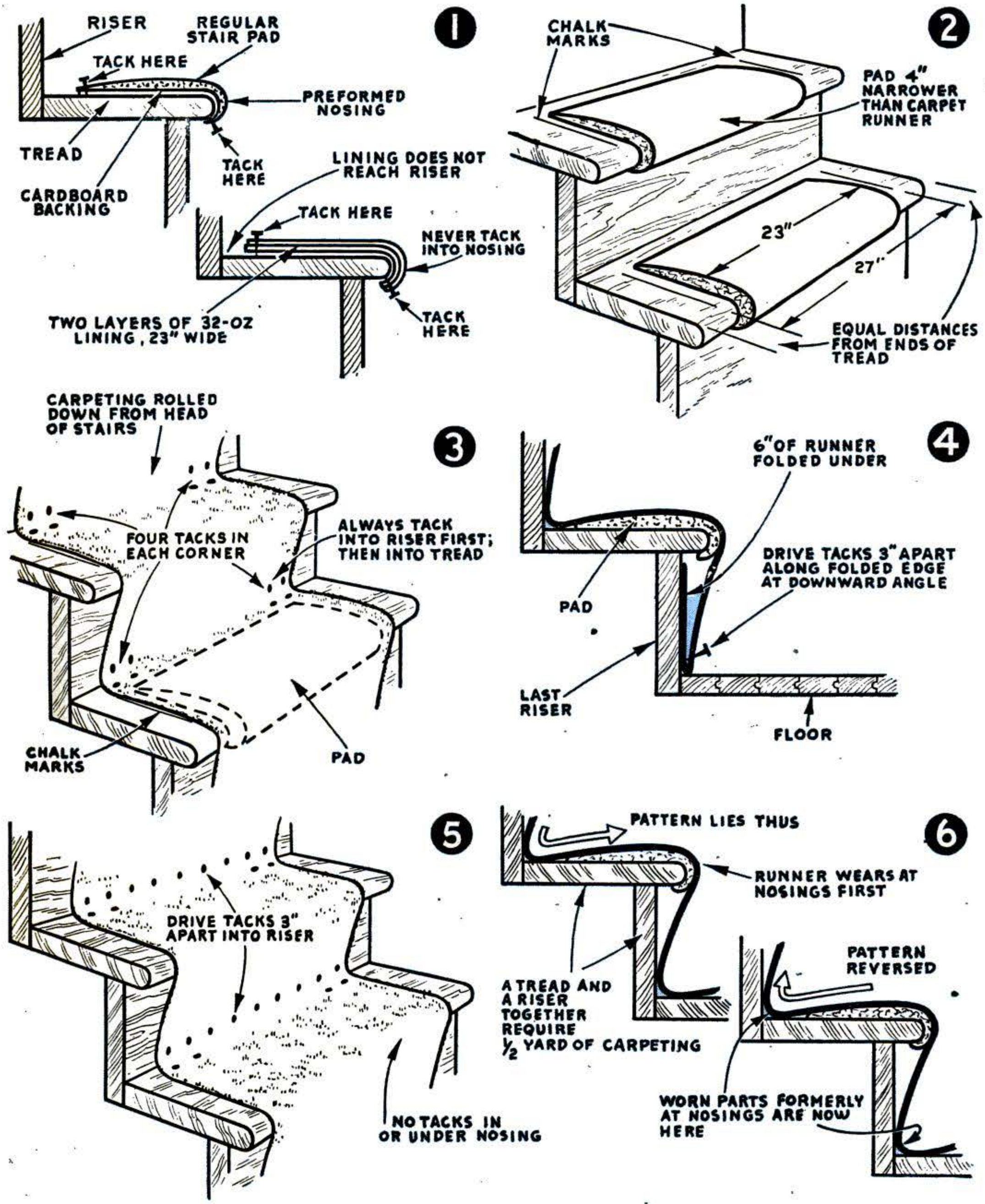
the nosing as this would destroy the "waterfall" effect that is the hallmark of the professional.

In addition to providing extra material for shrinkage, the 6″ folded under at the bottom riser permits reversing the runner on the stairway, as shown in Fig. 6, when wear begins to show at the nosings. When this is done, the previously turned-under part goes up to the head of the stairway, and the worn parts fit in at the inside corners of the risers where they escape further wear.

Worn parts can be shifted still another way on a staircase that turns at landings. Lay the top ends of new runners flush with the wall on the landings. Then, when wear begins to show, re-lay with the top end aligned with the edge of the runner above and trim off the bottom end. This puts the worn parts 2″ or 3″ below the nosings.



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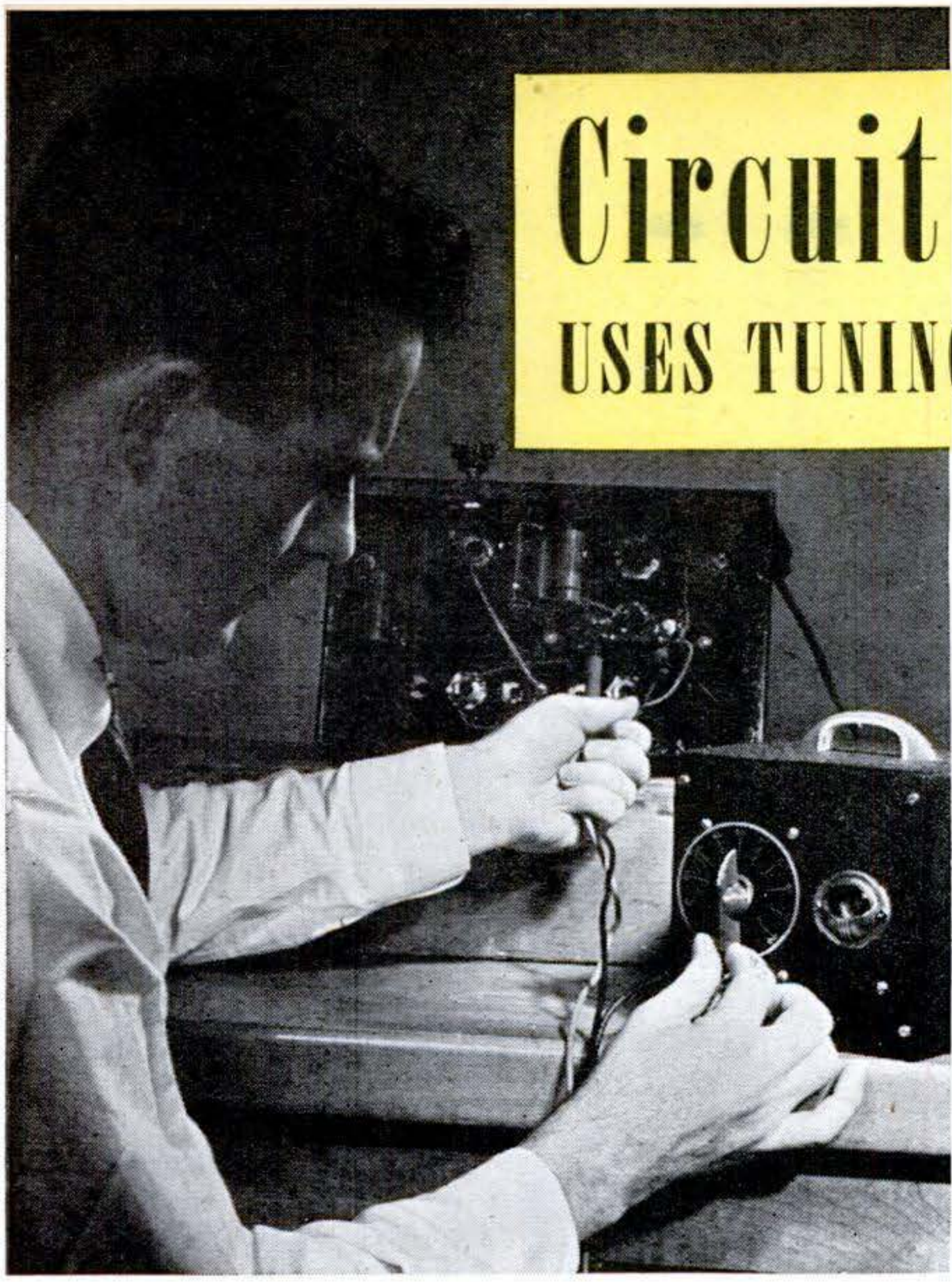
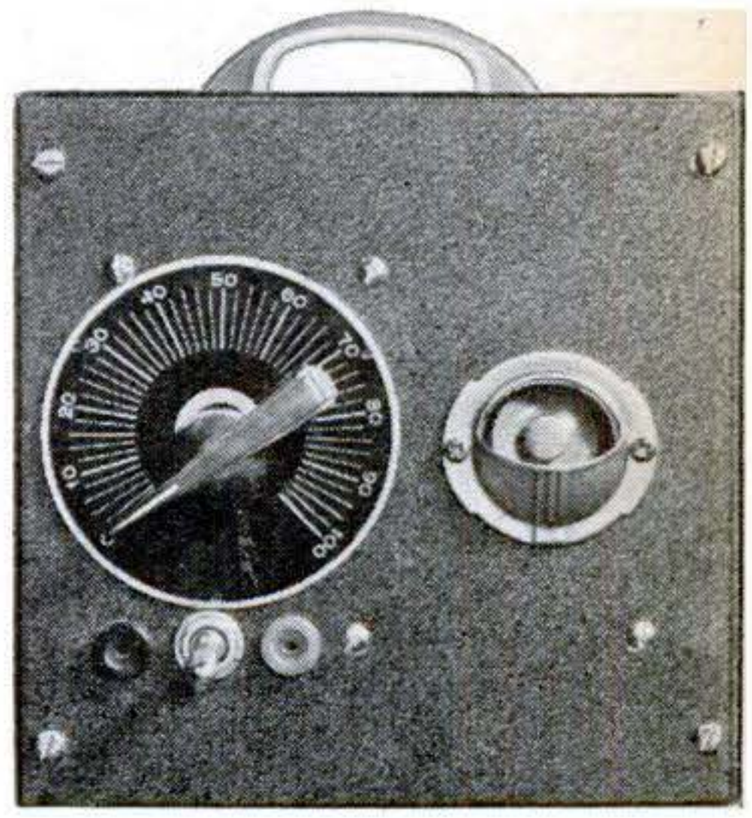
Circuit Tester

USES TUNING EYE AS METER



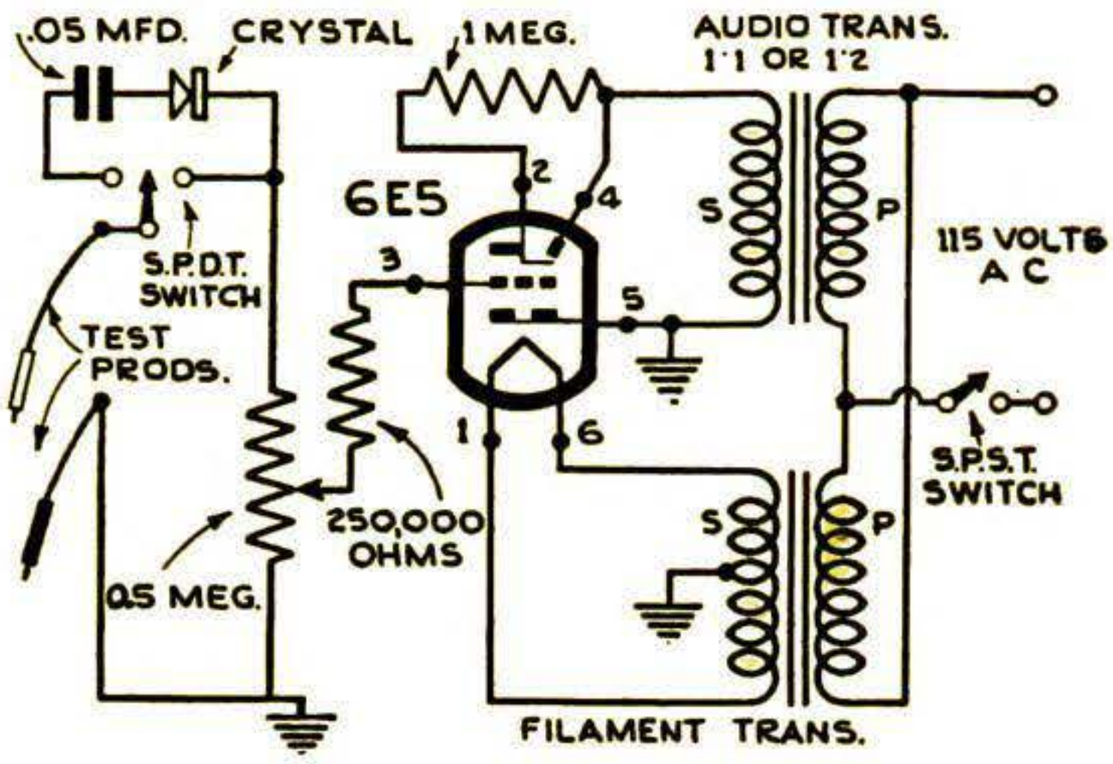


When correctly calibrated by the builder, this circuit tester will give accurate readings between 1.5 and 45 volts. The range can be extended by putting extra resistors in series with the potentiometer.

WITH a 6E5 tube serving as an indicator, this vacuum-tube voltmeter gives accurate readings from 1.5 to 45 volts, and will safely handle up to 90 volts, enabling the serviceman to check for moderate screen and plate voltages. A detector circuit rectifies signal voltages, making it possible to trace and test A. C. as well as D. C. Although it has the no-load advantages of more expensive vacuum-tube meters, this tester can be built at moderate cost.

The entire assembly is mounted on the front panel of a 6″ by 6″ by 6″ metal cabinet. A standard 6.3-volt filament transformer delivering 1 amp. in the secondary heats the 6E5 tube, and an audio transformer is pressed into service as a power transformer. With a fixed crystal detector and a protective .05-mfd., 600-volt condenser, the tester is able to detect an A. C. signal.

To calibrate the scale, apply several known voltages, and adjust the potentiometer for each one until the angle of the eye is at minimum. With a straight-line potentiometer it is only necessary to obtain a few typical readings from which intermediate values can be calculated. To increase the range of the meter, add a 250,000-ohm resistor between the potentiometer and ground.—N. C. HEKIMIAN.



The S.P.D.T. switch on the input side cuts in a fixed crystal detector for testing A.C. circuits.

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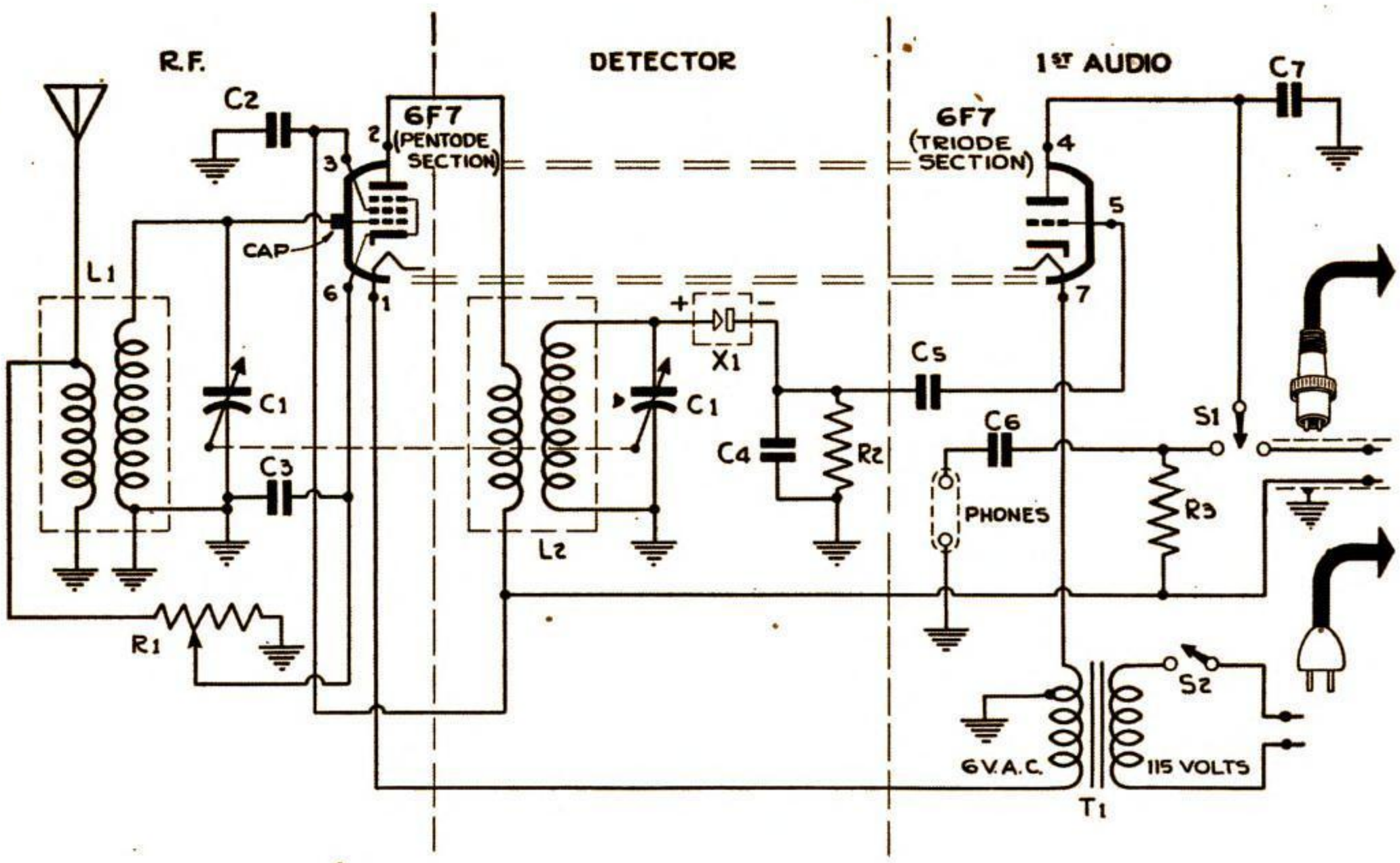

The cathode-regenerative circuit employed in this one-tube tuner is free of whistles and howls, and causes no interference with other radios. A tiny new crystal used in wartime radar equipment acts as the detector, replacing the more conventional diode.

High Fidelity WITH TWO TUBES

Neatly laid out and with all internal wiring below the two metal chassis, the rig can be housed vertically or horizontally in a cabinet. The speaker should be fitted to a baffle for best tone quality.

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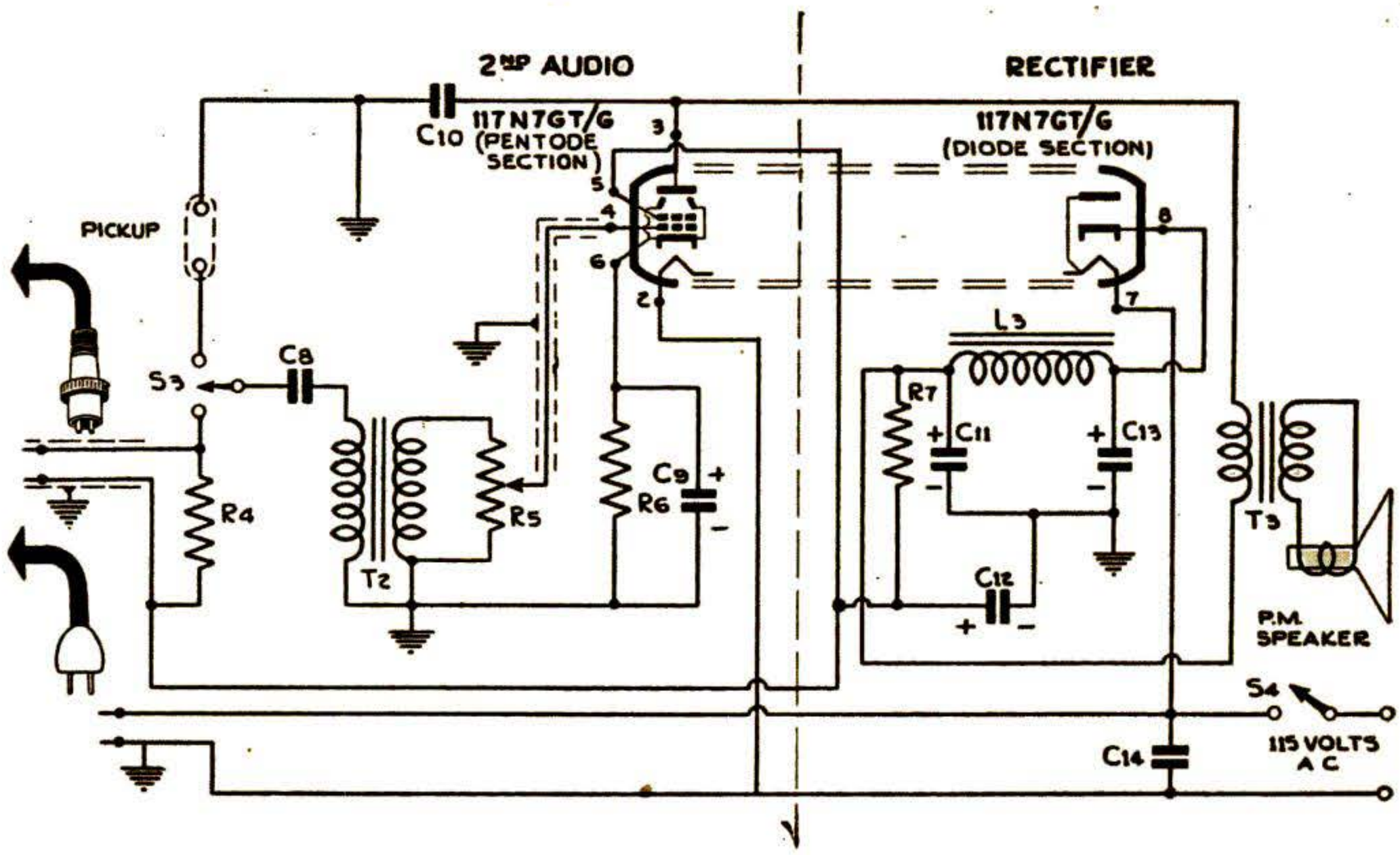

One stage of amplification is enough to drive a 12" speaker at comfortable volume, but a smaller unit can be used if preferred. When operating with a phonograph, the amplifier gives best results if coupled to a crystal pickup of the high-output type.

Dual-Purpose Tubes Provide Five Stages in Unusual Circuit

By WILLIAM NORTON

A CIRCUIT design that makes most of the components double up or perform some extra function is largely responsible for the high quality of reception possible with this two-tube receiver. Each of the tubes actually contains two separate sections within its glass envelope, and a war-born development replaces the detector tube, adding up to five stages in all

About the size of a small resistor, the new part, X1 in the diagram, is actually the old familiar crystal detector in a new dress Engineered for use in compact radar equipment, the midget crystal is now being offered to radio builders as a replacement for all types of diode-detector circuits. Available with pigtail leads for wiring into the set, it not only saves space but eliminates the need for a filament current, resulting in cooler operation with no sacrifice—and possibly some gain—in performance The crystal is factory adjusted, and its "cat's whisker" is imbedded in wax for uniform, shock-resistant service

Also contributing to the set's high fidelity is the use of an audio transformer, employed here in a somewhat unconventional circuit The transformer, T2, has a ratio of 3.5 to 1, and, as used with both B-plus and C-minus leads soldered to the chassis, carries no plate voltage in its primary winding This tends to give a flatter response curve—that is, more uniform amplification of signal voltage and reproduction of the musical and voice ranges.

The elaborate filter circuit adds its share to smooth performance. Output from the half-wave rectifier is first filtered through the heavy-duty choke, L3, and electrolytic condensers C11 and C13. It is then further

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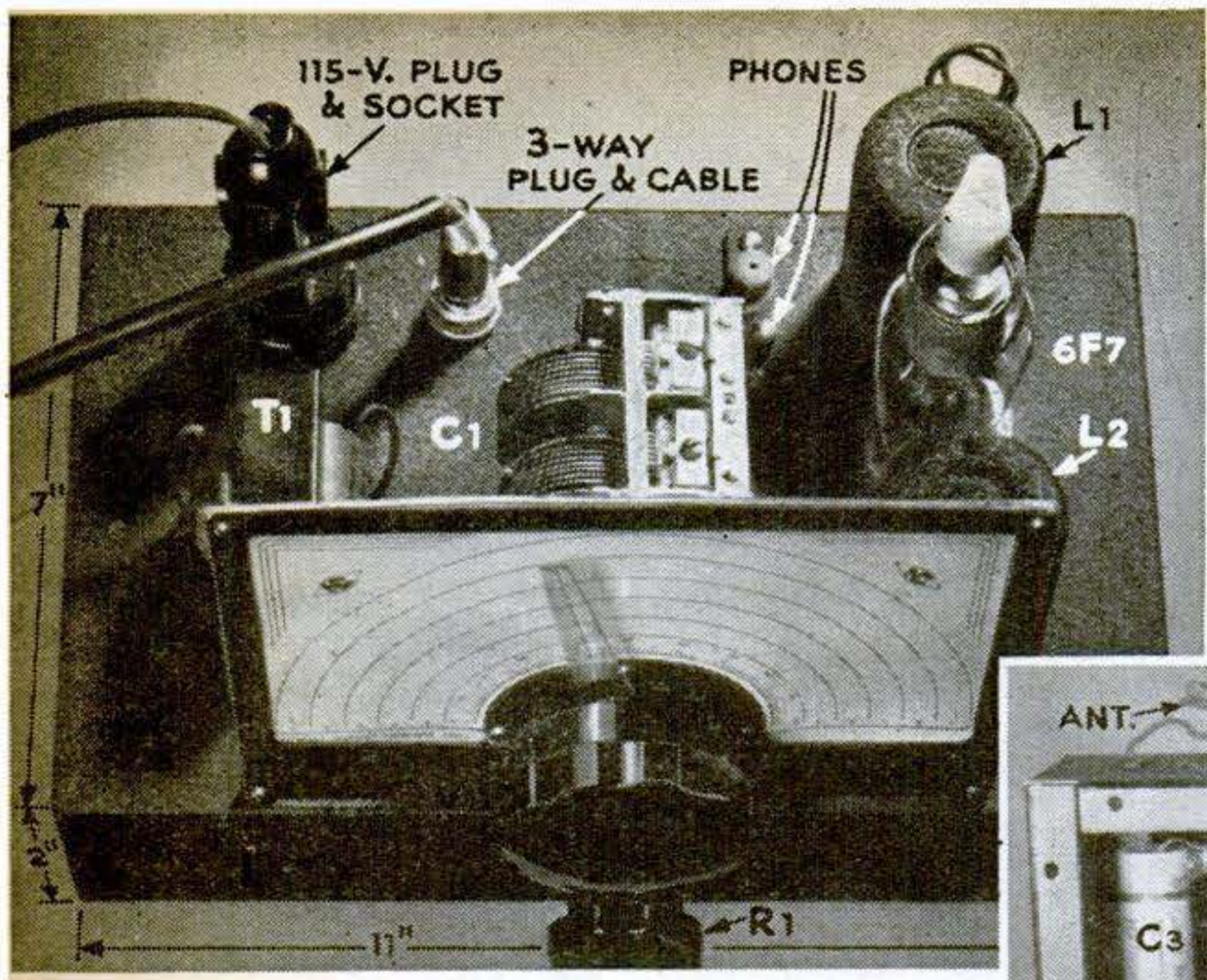
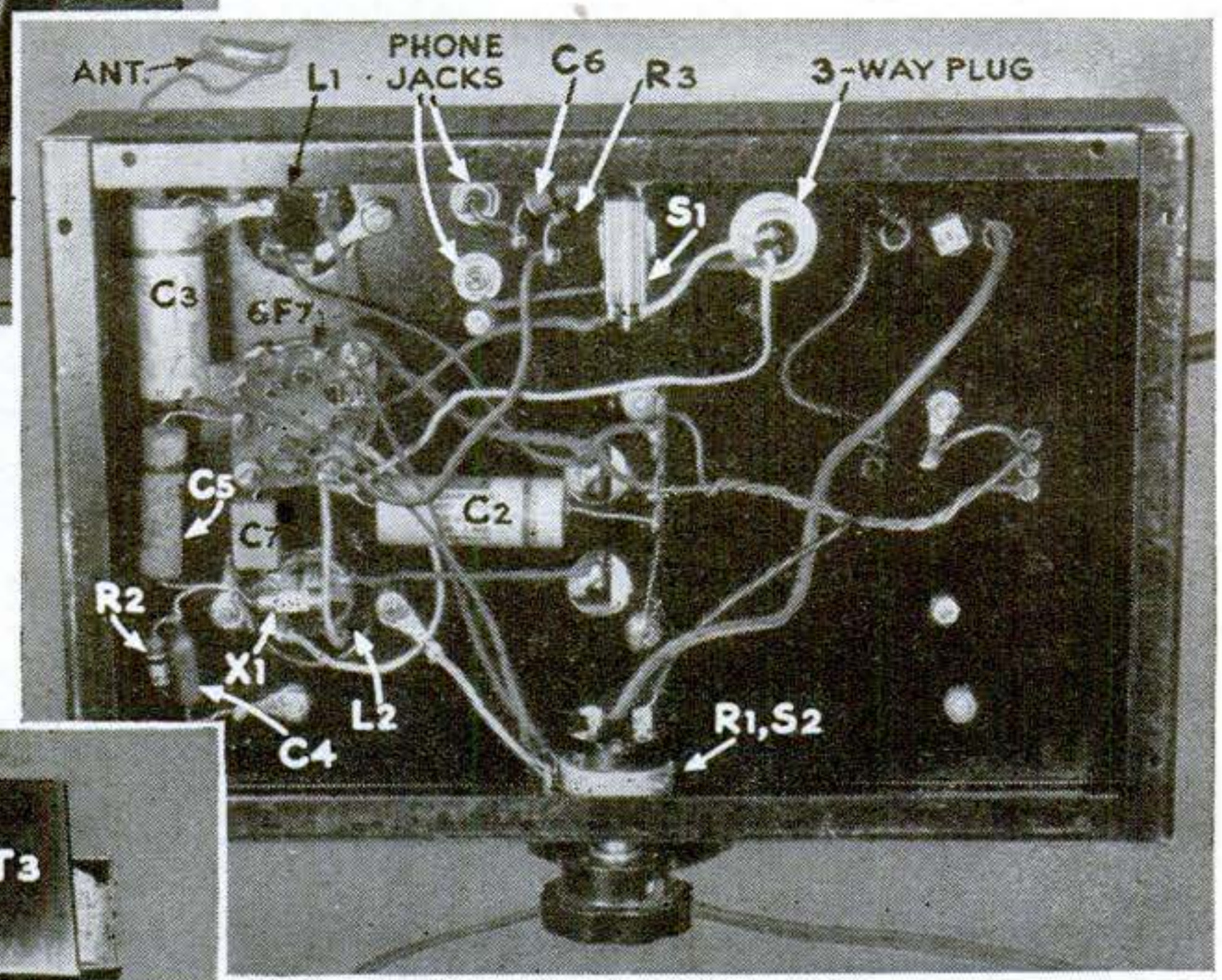
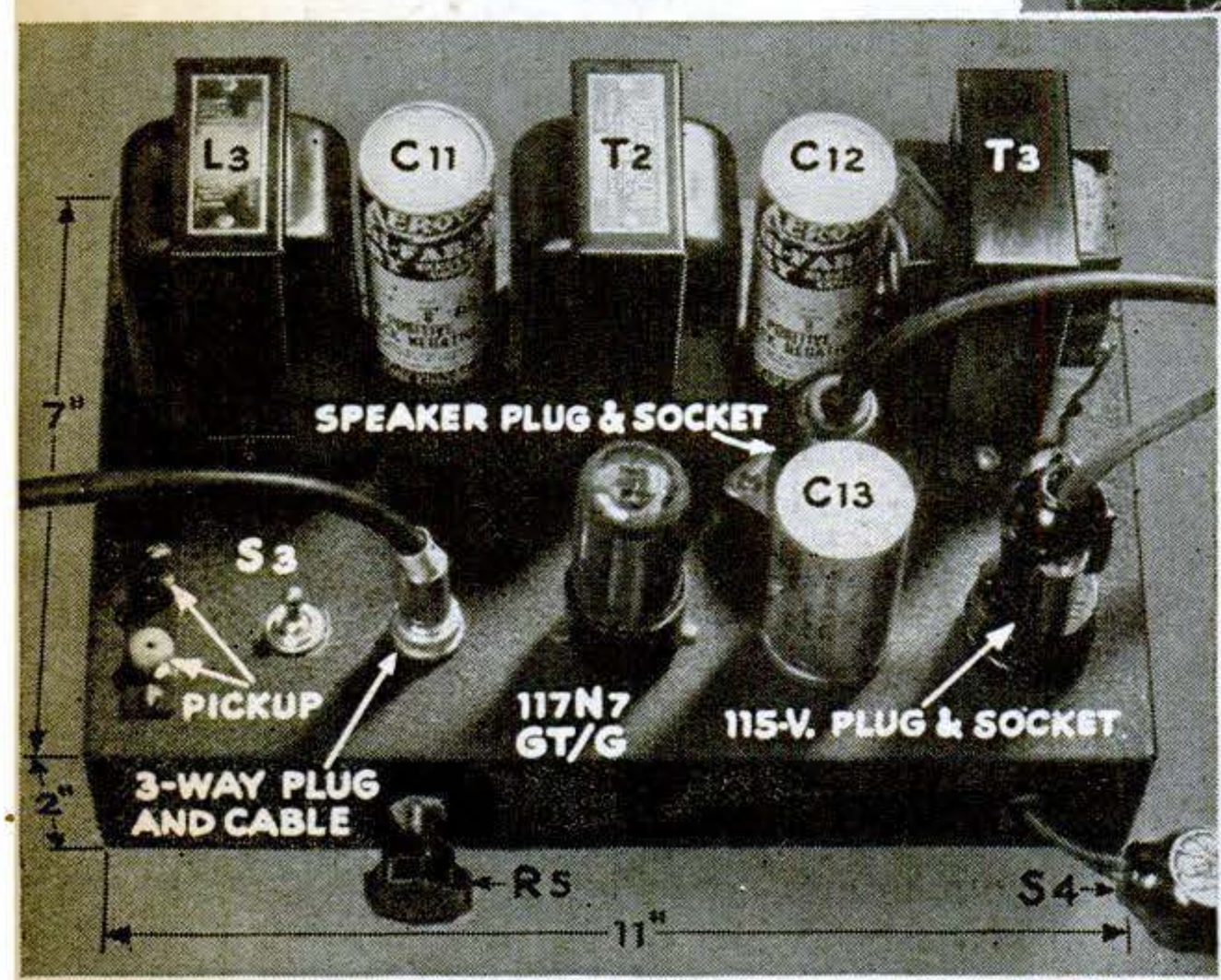


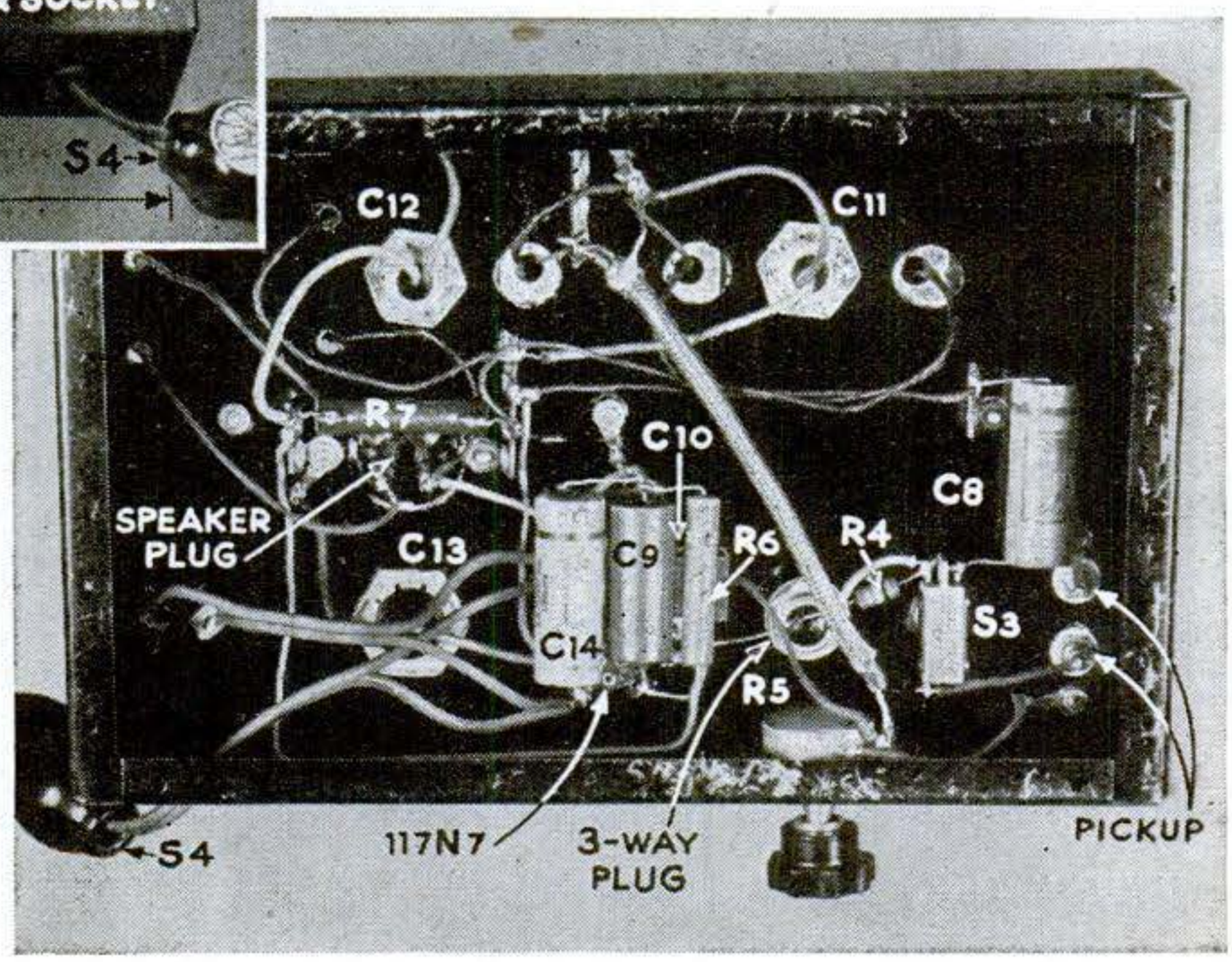
Tuning and regeneration controls are both placed on the front of the first chassis. The regeneration control also acts as one of the two volume controls on the radio. To align the set, adjust the trimmers on top of C1. Ink the call letters of local stations on the dial for easy reference after you have logged all of them.



The size of the metal chassis allows ample room for neat wiring. Note the tiny fixed crystal detector X1; it takes the place of an extra tube, but is no larger than a ½-watt resistor.



Large transformers and electrolytic condensers contribute to the over-all efficiency and tone of the finished receiver. They also give the set a handsome, professional appearance.



Note the shielded wire used between the grid of the 117N7 and the volume control, R5. The latter shunts the secondary of the audio transformer. The feed-through switch, S4, can be combined with the potentiometer or replaced by a separate panel switch.

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filtered through R7 and C12. Tapped off the choke, the voltage that reaches the plate of the 117N7 is higher than the one that gets to the screen.

Fidelity of sound reproduction generally requires that the plate impedance of the output tube be matched to the impedance of the speaker. This is done with an output transformer that has several taps in the secondary winding. By selecting the right ones, any speaker can be matched to the tube through the simple trial-and-error system of testing various taps until the most pleasing tone reproduction is obtained. There is enough power in this set to drive a 12″ speaker, but if the full bass rendition of a large speaker is not required, an 8″ or 10″ unit may be used instead.

To make the tuner and audio amplifier sections independent of each other, two metal chassis blanks were used. The first 2″ by 7″ by 11″ unit contains the radio-frequency, detector, and first-audio stages; the other holds the second-audio amplifier and the rectifier. A black crackle finish on the metal enhances the appearance of the work and lends a professional touch to the equipment. Used alone, the tuner will give excellent reception on headphones; alternatively, the amplifier can be used with either a microphone or a phonograph pick-up. Switches S1 and S3 allow individual operation.

As only one stage of audio amplification is provided for a phonograph, a high-output pickup is needed to obtain high volume. For most satisfactory performance, one of the new crystal pickups with a signal output of about 4.5 volts should be used.

Air-core coils are used in the R.F. stage, but shielded iron-core coils may be substituted if they are easier to obtain locally. The coils are tuned by a two-gang .000365-mfd. variable condenser against a dial that can be marked with the call letters of local stations. Dials of this type are furnished with several blanks so that new station letters can be written in if the set is retuned or moved to a new location.

Extremely stable regeneration, free of whistles, hoots, and howls, is provided by the cathode-regenerative circuit, and controlled by R1. This type of regeneration boosts the power of the receiver but does not interfere with neighboring radios. By using external line switch S4, and a second volume control, R5, it is possible to leave the regeneration control set at the point where reception is best. No ground is needed, but if one is used it should be connected to the chassis through a .1-mfd., 600-volt condenser to prevent any possibility of shorting the 115-volt line. In some neighborhoods the receiver will give adequate volume with a very small antenna, or even none at all; in others anything from a 20′ indoor line to an outdoor antenna of 100′ or more may be needed.

Because this set is capable of quality sound reproduction, it deserves a cabinet that will help rather than hinder its tone. The speaker should be mounted on a baffle to prevent loss of low notes and an over-all tinny sound. The cabinet should be chosen with an eye to the versatility of the two units that make up the receiver. If you plan to use a phonograph with the amplifier, some provision should be made to house it. The changeover switch, S3, may be moved if necessary to make it easily accessible outside a closed cabinet. Similarly, the headphone attachment on the tuner and switch S1 may be shifted so that phones can be plugged in with the least difficulty. If the set is destined to remain in your workshop, the metal chassis can be mounted at any angle on the walls or bench.

LIST OF PARTS

R1: 50,000-ohm potentiometer, with switch.
R2, R3, R4: 100,000 ohms, ½ watt.
R5: 500,000-ohm pot.
R6: 600 ohms, 2 watts.
R7: 500 ohms, 10 watts.
C1: .000365-mfd. two-gang tuning condenser.
C2, C3, C8, C14: .1-mfd., 600 volts.
C4: .0002-mfd. mica.
C5, C6: .05-mfd., 600 volts.
C7: 00025-mfd., mica.
C9: 25-mfd., 50-volt electrolytic.
C10: .003-mfd., mica.
C11, C12: 8-mfd., 450-volt electrolytic.
C13: 20-mfd., 450-volt electrolytic.
L1: Shielded air-core antenna coil.
L2: Shielded air-core R.F. coil.
L3: Shielded filter choke, 10 to 20 henries, 200 to 600 ohms.
T1: Filament trans. 6.3-volt, 1-amp. secondary.
T2: Shielded audio trans., 3.5 to 1 ratio.
T3: Output trans., tapped secondary.
X1: 1N34 midget crystal detector.
S1, S3: S.P.D.T. toggle switches.
S2: S.P.S.T. See R1.
S4: S.P.S.T.
Tubes, sockets, P.M. speaker, dial, cable, plugs, misc. hardware.

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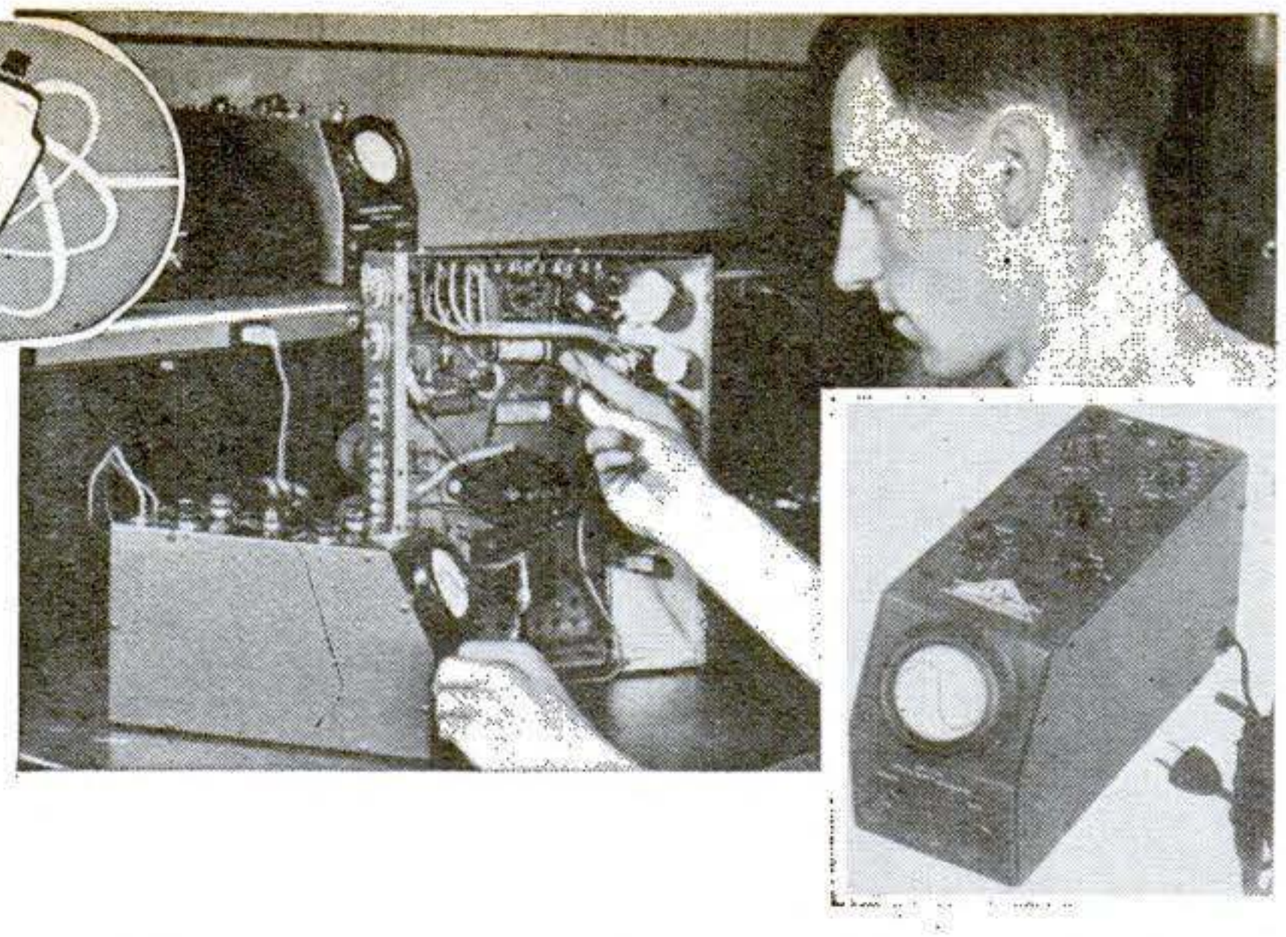
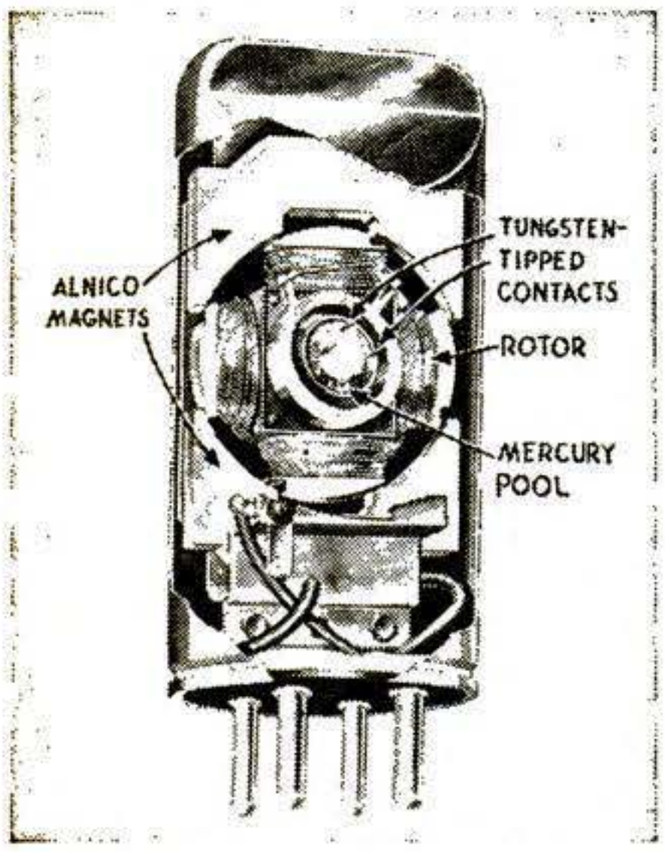
NEWS IN ELECTRONICS

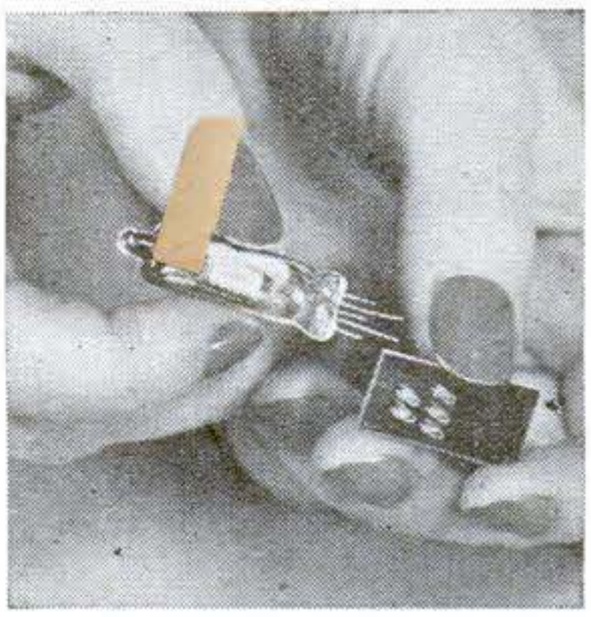


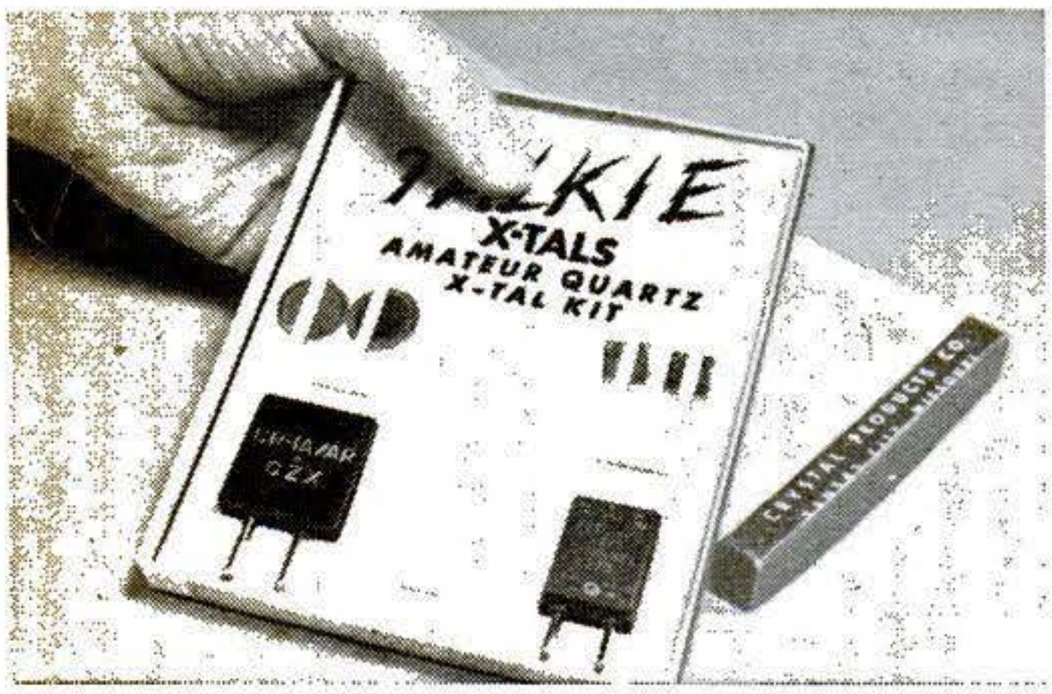


ROTARY ACTION is said to give this converter longer life and higher efficiency than the conventional reed-type vibrator used in car radios. Ohio Tool Company, of Cleveland, is the manufacturer.

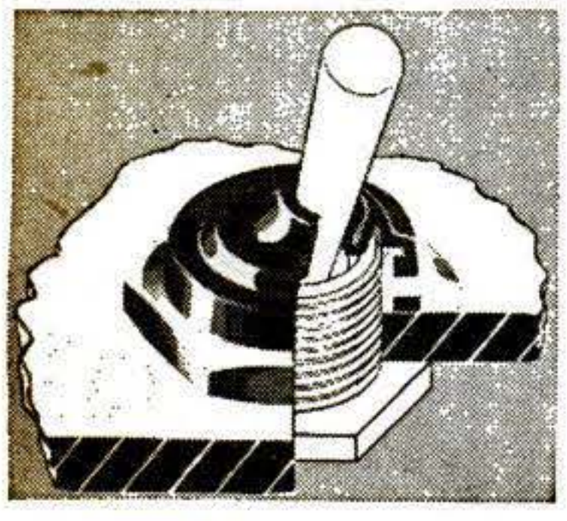
BABY OSCILLOSCOPES having all the chief features of the larger 'scopes will make it possible for well-equipped servicemen to do more checking and testing on outside calls. This compact, complete model uses a 2″ cathode-ray tube; it is made by the Waterman Products Company, of Philadelphia.

MINIATURE tube sockets, being produced by Instrument Specialties, of Little Falls, N. J., will make it simpler for experimenters to install and replace the pint-sized parts. Soldered connections are made to clip contacts instead of to the tube leads.





CRYSTALS GROUND TO ORDER will give the amateur greater freedom in the construction of ham-band transmitters. The kit shown at the left contains three crystals, together with holders, metal contact disks, and the necessary equipment for grinding the crystals to any desired frequency within the band limits. The amateur can keep check on his frequency by testing the crystal in a transmitter and tuning in the signal on his receiver; he can pick the frequency that gives the best local results.



MOISTUREPROOF SWITCH MOUNTINGS are possible on any equipment with war-developed moisture seals, made originally for Navy installations. The sealing nut and sleeve, product of Radio Frequency Laboratories, Inc., of Boonton, N. J., is available in various sizes and styles for sealing control shafts wherever the presence of moisture, dust, or corrosive fumes makes it desirable.

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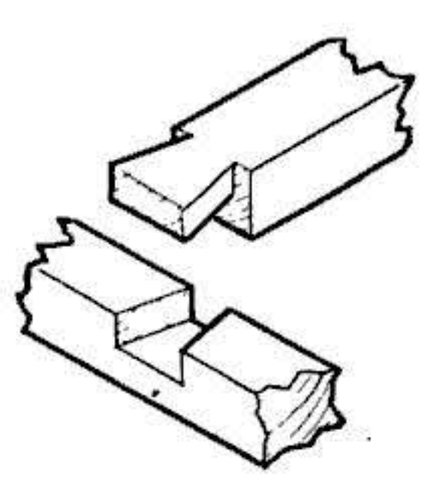
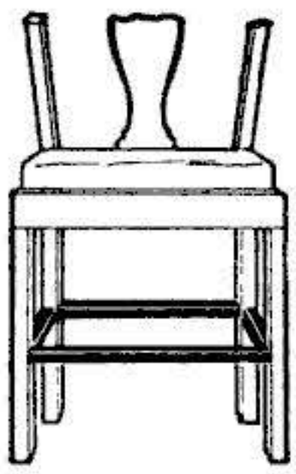
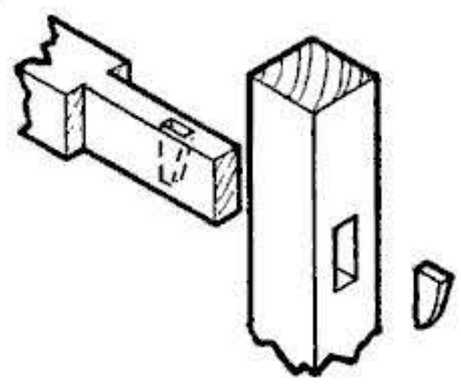
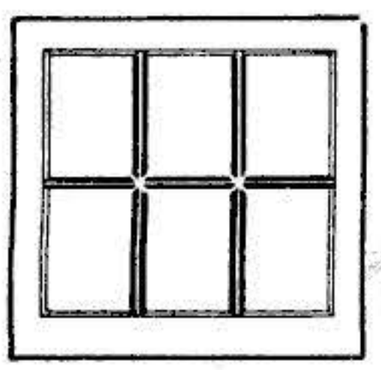
Woodworking QUIZ

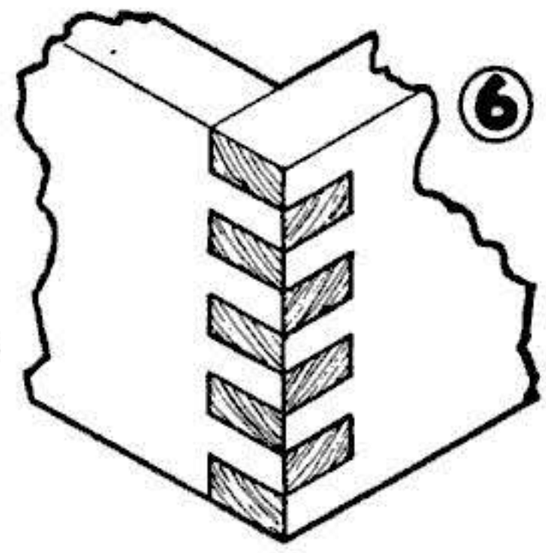


SHOWN in the accompanying drawings are wooden parts (in black) and joints that you see every day. How many of them can you name? Write your answers on a piece of paper, and then turn this page upside down and check your answers against the correct ones given below.



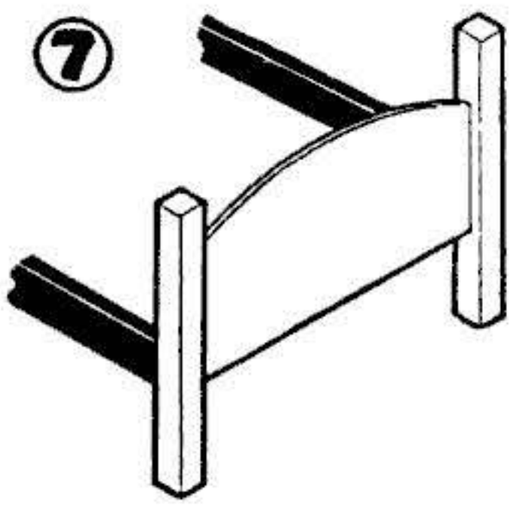


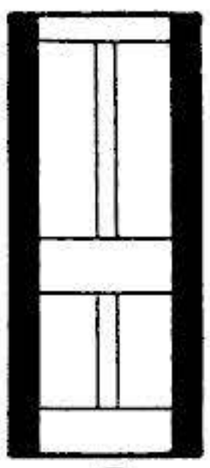


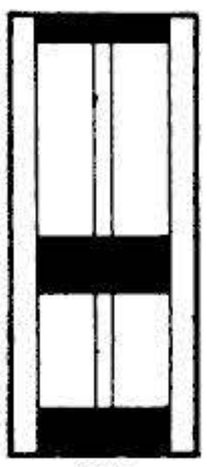


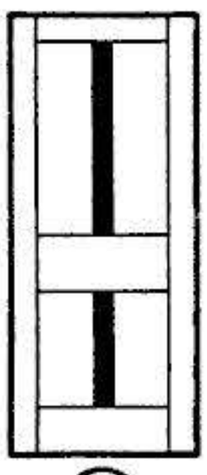
ANSWERS

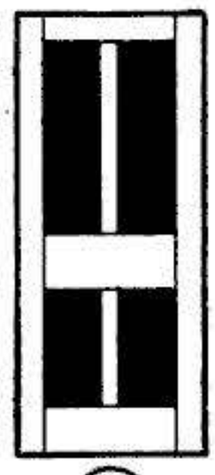
1. Splat.
2. Lap-dovetail joint.
3. Stretchers, rungs, or rounds.
4. Keyed or wedged mortise-and-tenon joint.
5. Window muntins or sash bars.
6. Finger joint.
7. Rails of a bed.
8. Door stiles.
9. Door rails.
10. Door mullions or muntins.
11. Door panels.
12. Apron.

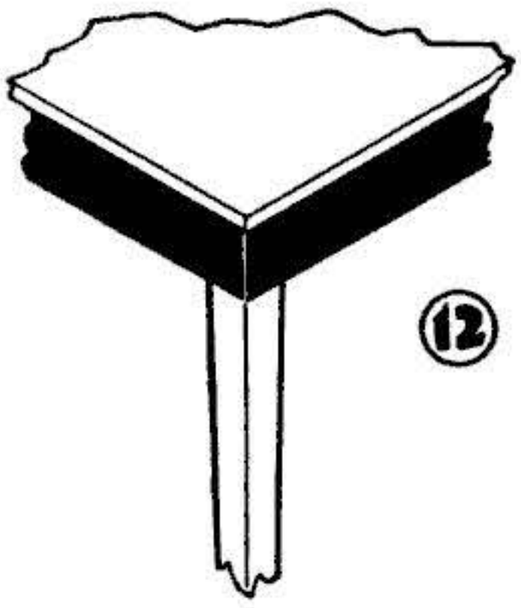


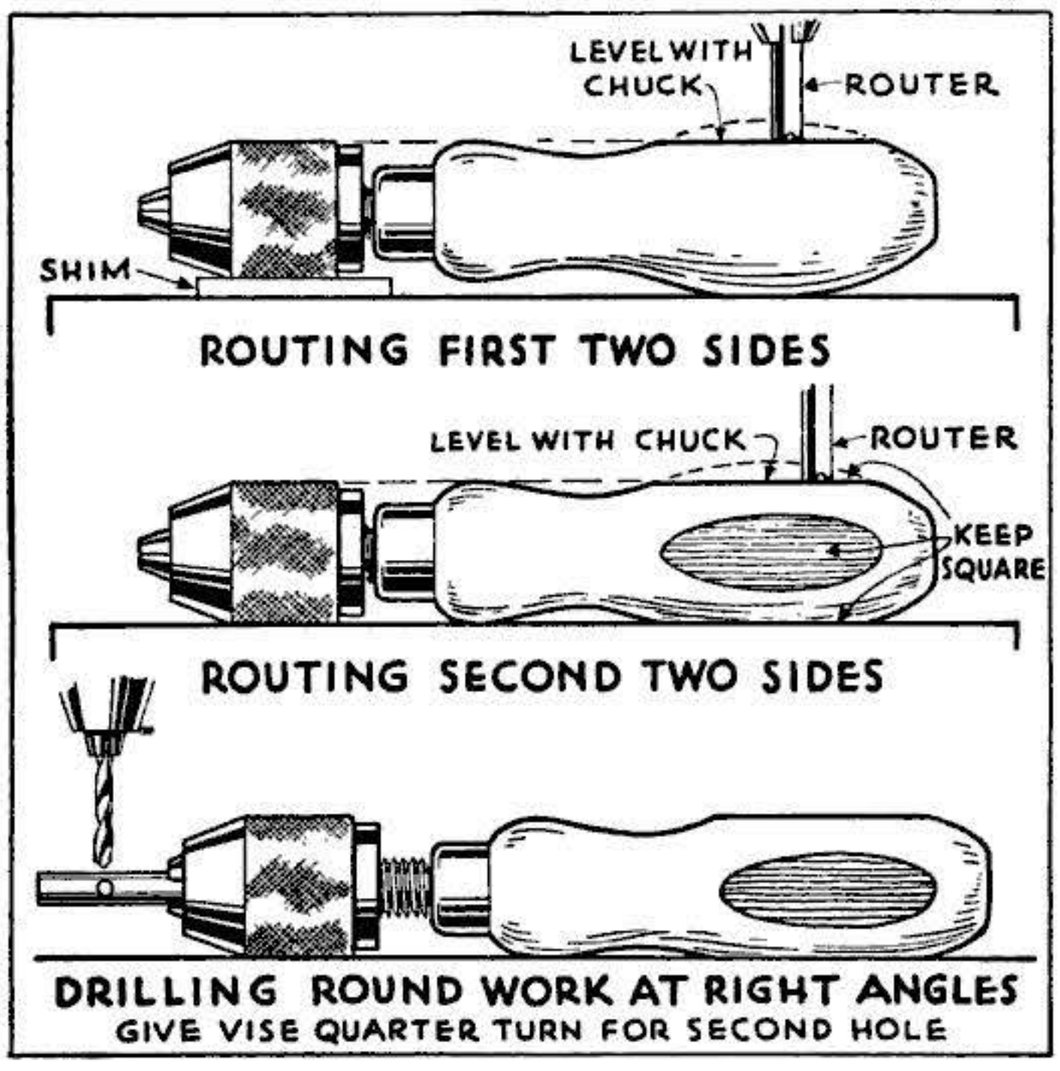












Pin Vise with Squared Handle

DRILLING right-angle holes in small round work or squaring a dowel is easy if you have a pin vise with a squared handle. The work is held in the vise on the drill-press table and the first hole drilled or the first side routed; then the vise is flipped a quarter turn and the second hole or flat made. If opposite sides of a dowel are to be flattened, the vise is given a half turn.

To square a pin-vise handle, place the vise under the router bit with the chuck on a block to put the axis on a horizontal plane, and rout two sides at exact right angles. Then remove the block to rout the two opposite sides. All faces should be level with the chuck.—HERBERT PFISTER.

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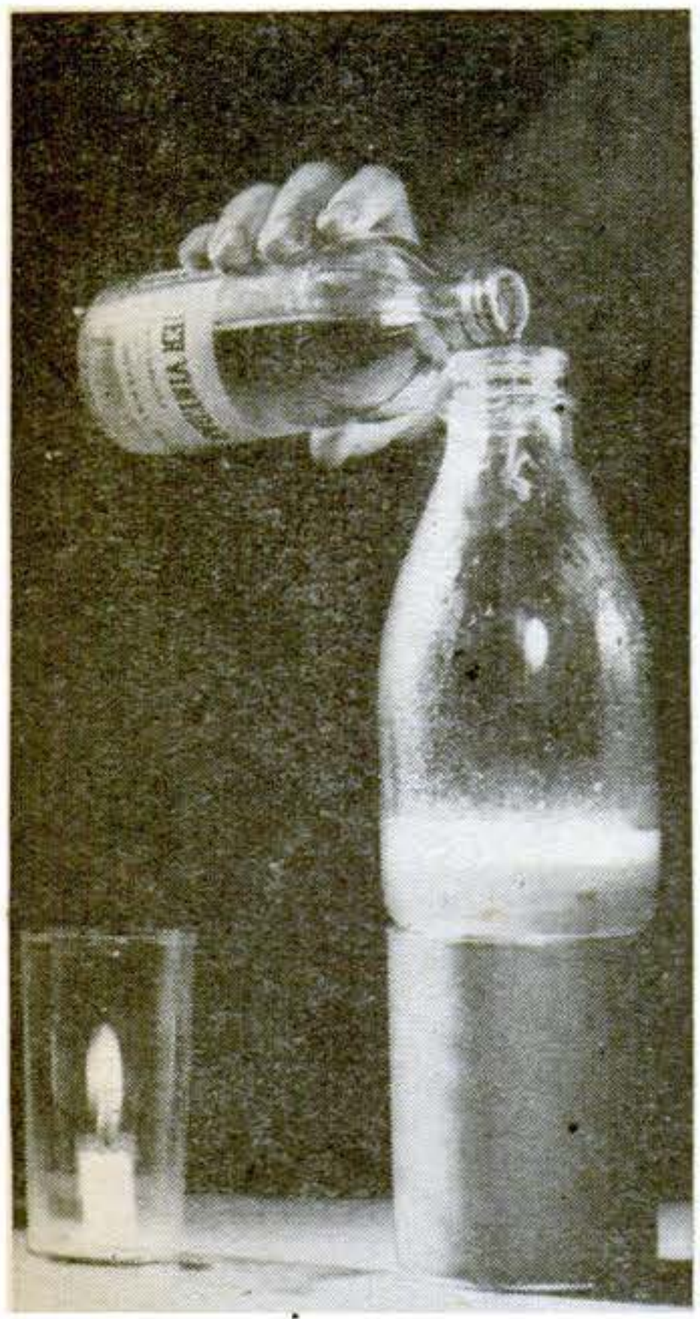
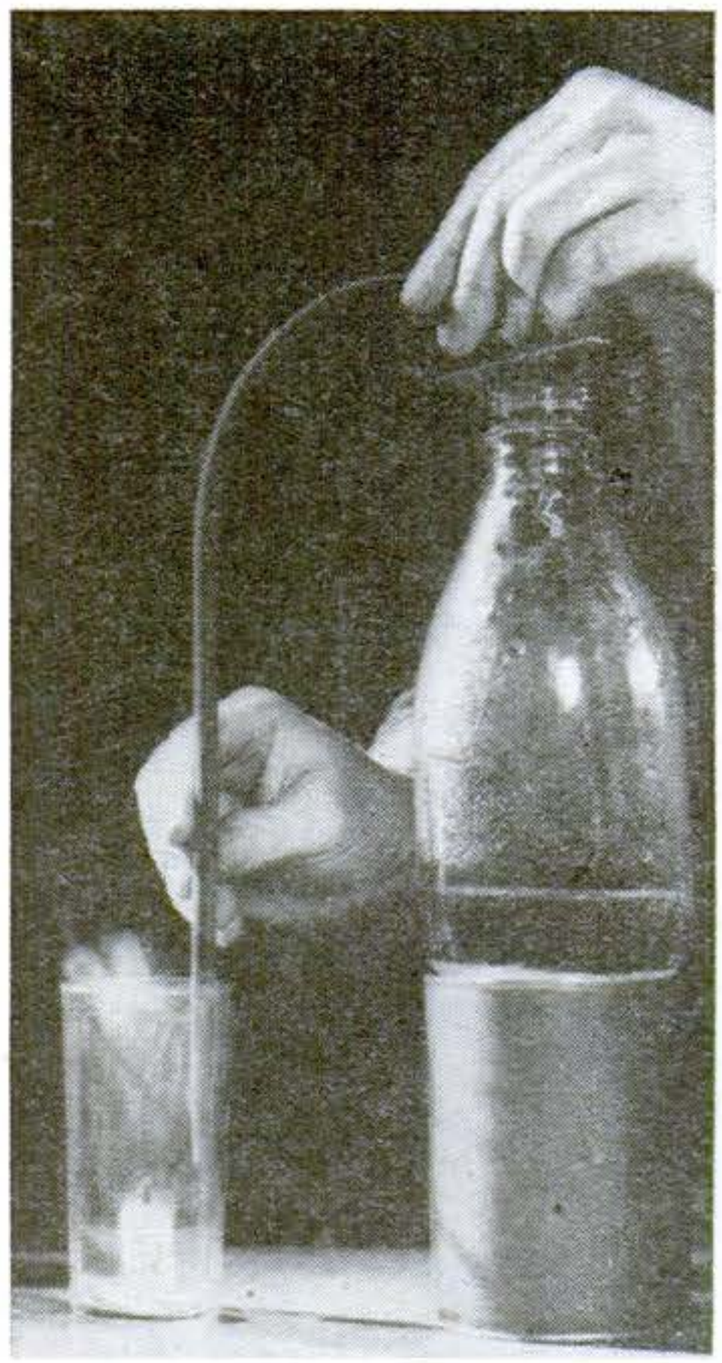
HOME EXPERIMENTS

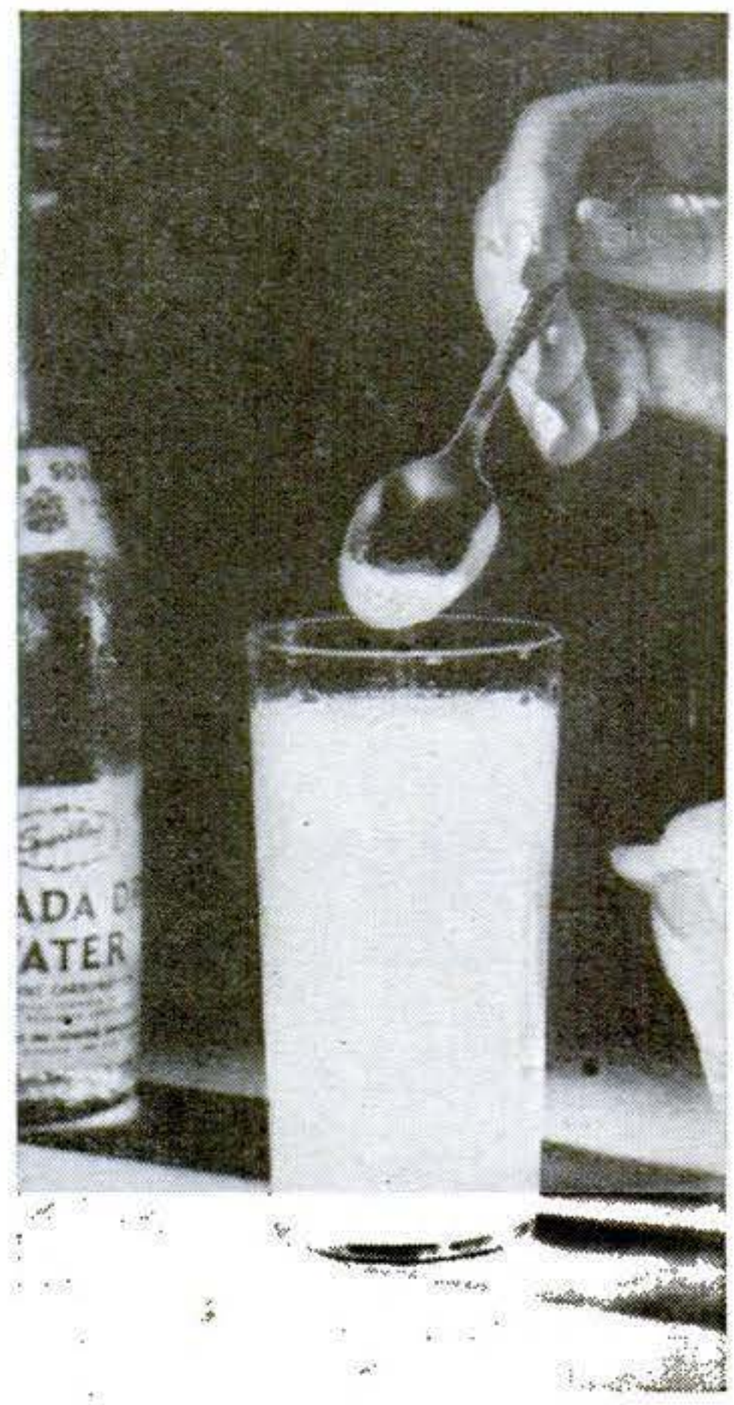
GASES UNDER PRESSURE





SIPHONING of liquids is familiar to everyone, but did you realize that a heavy gas also can be siphoned? Light a candle in a glass, set a milk bottle above and beside the glass, and make carbon dioxide in the bottle by adding vinegar to strong baking-soda solution. Insert a rubber tube to about 1″ above the liquid and cover the bottle around the tube. After a minute, when the tube will be full of gas, uncover the bottle. Place the free end of the tube in the glass with the candle. The candle soon will go out, showing that the heavy carbon dioxide has been siphoned to the glass.

SODA WATER bubbles violently if you add ice cream, syrup, or other substance. This experiment will indicate why. Pour some carbonated water into a clean glass and note that, after a few seconds, very few bubbles are visible. But add ½ teaspoonful of sugar, or a little of almost any other solid substance, and vigorous bubbling takes place. When the liquid is first poured, carbon dioxide gas is held in suspension throughout the soda water. If you add a substance such as sugar, the particles serve as focal points around which gas molecules rapidly accumulate to form bubbles that rise to the surface.



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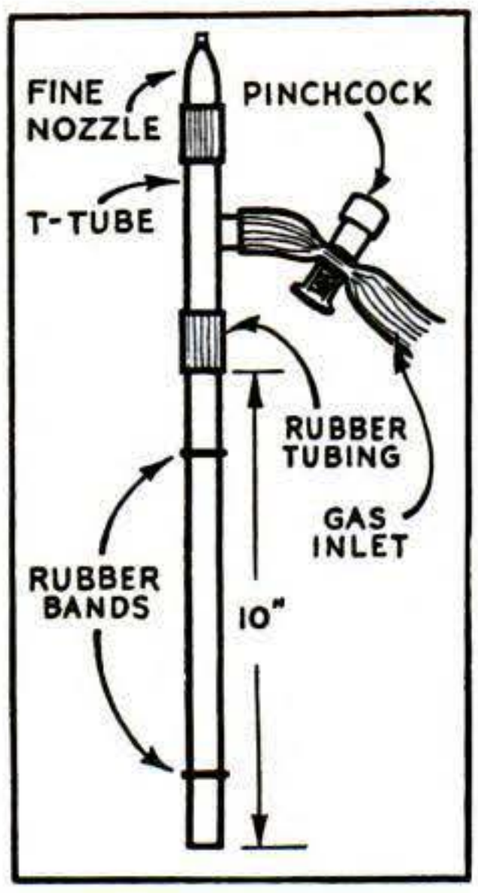
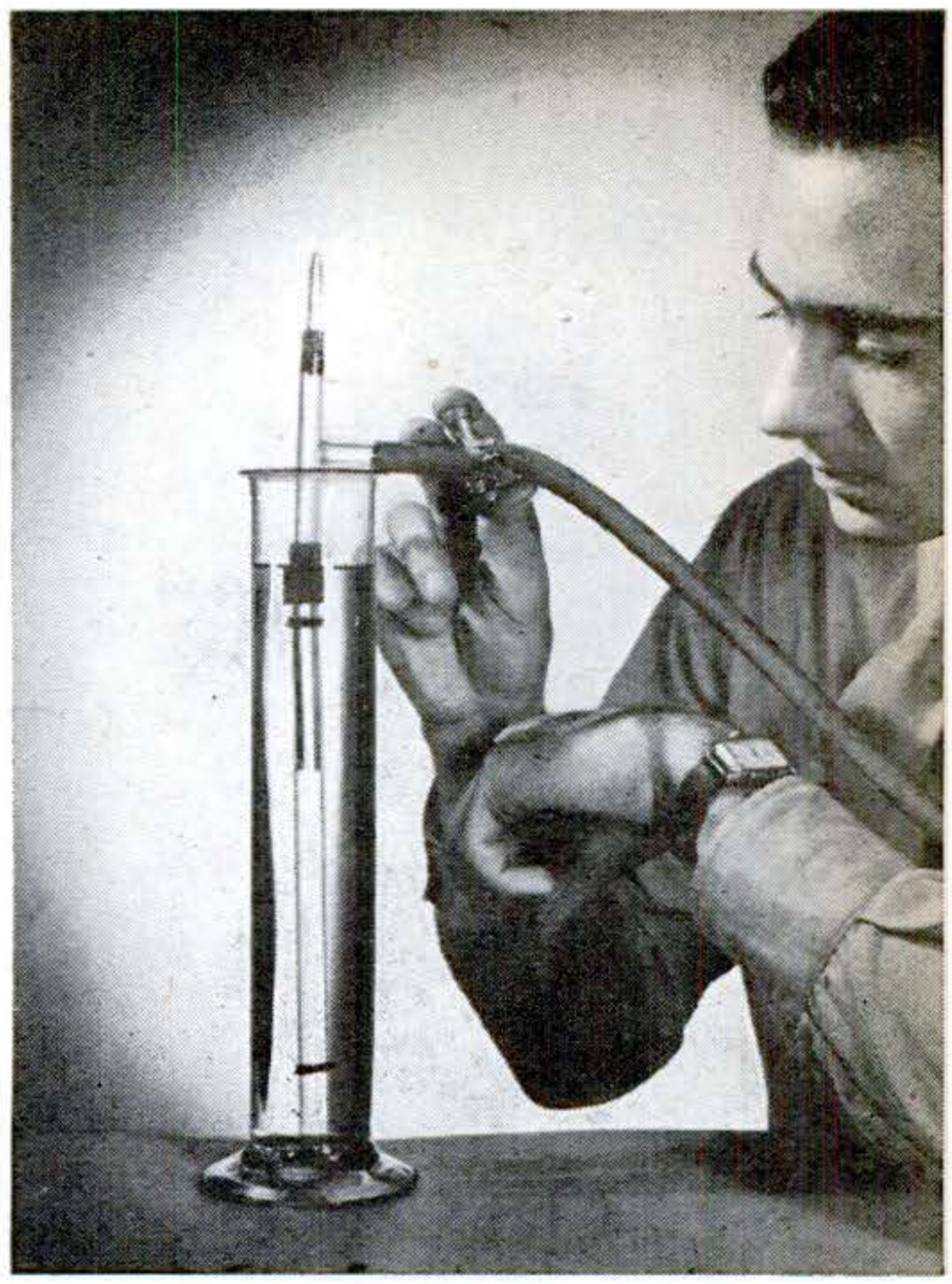
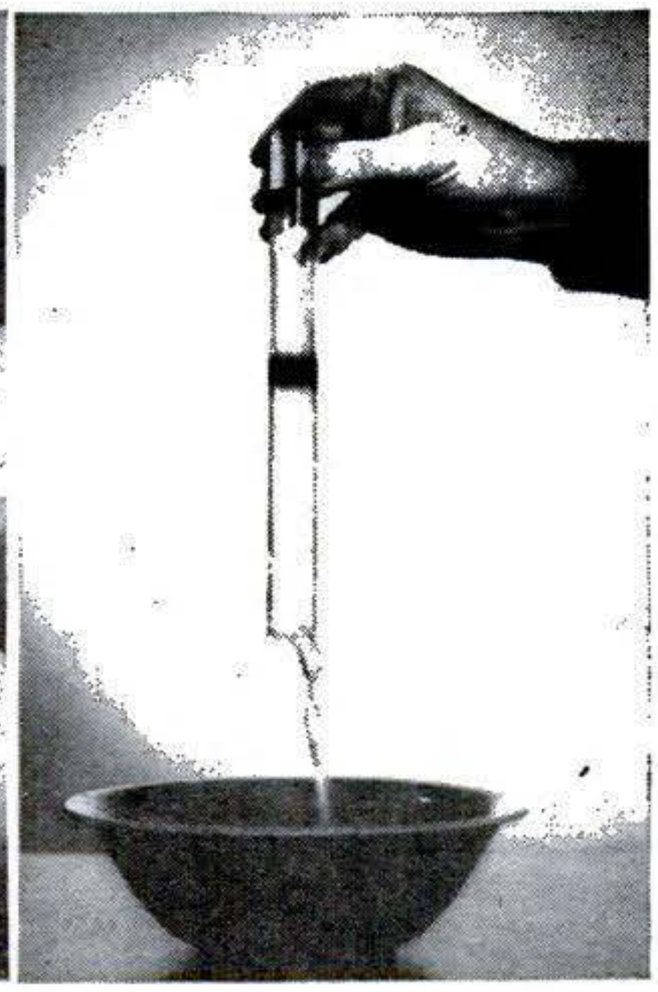
RELATIVE DENSITIES of gases can be measured by means of the apparatus shown below and at the right. Close the pinchcock and set the apparatus in a tall jar of water. Air begins at once to escape from the fine hole in the glass nozzle. With a watch, record the time required for the water level in the tube to rise from the lower band to the top one. This will be the time required for a given quantity of air to escape through a hole of a certain diameter. This time serves as a means of measurement. Since a lighter gas will escape faster and a heavier one more slowly, you can find the relative density of a gas by filling the tube through the pinchcock and then squaring the time it takes the gas to escape and dividing by the square of that for air.

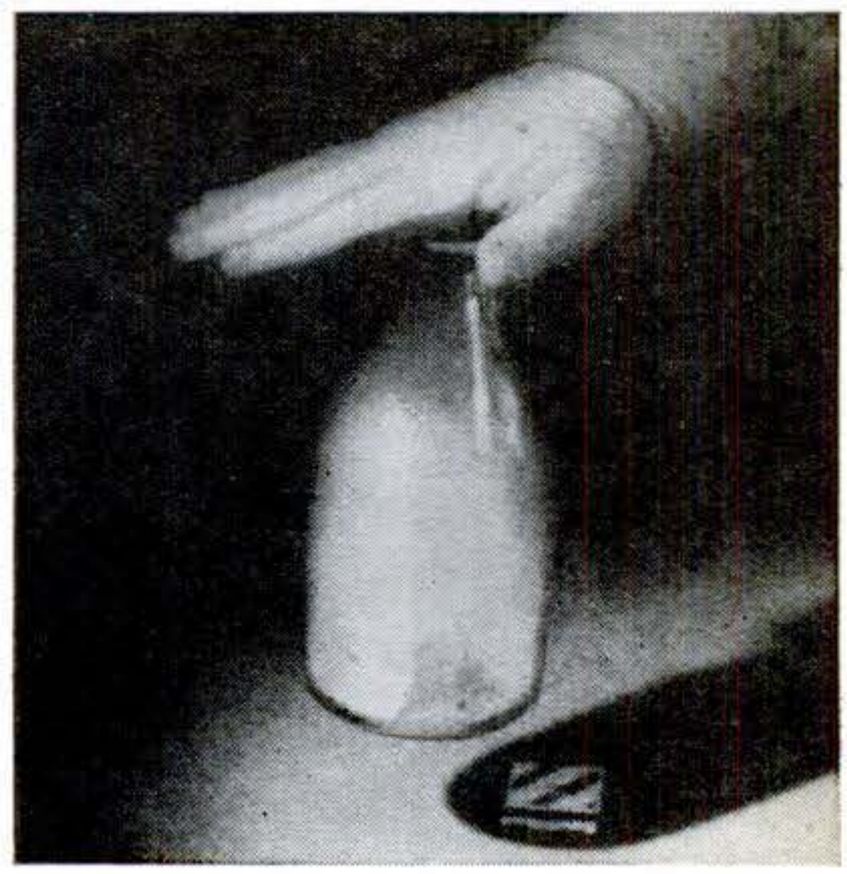






THE MAGIC VIAL. Cork one end of a 12″ glass tube 1″ in diameter, fill it with water, and insert a small stoppered vial until its top is depressed even with the top of the tube. Now place your hand over the top of the tube, invert it, and remove your hand. Does the vial fall out? Not at all. It rises. As water runs out, surface tension around the vial prevents air from entering. Consequently, the pressure above the vial is reduced and the air pressure below, being greater, pushes the vial up into the tube.

A MILK BOTTLE can be made to cling to the palm of your outstretched hand by applying a simple principle of science. Crumple a small piece of paper, drop it in the bottle, and ignite it. When the paper is partly burned, place your palm firmly over the bottle mouth. The flame soon will go out and you will find that the bottle clings to your palm. By burning away part of the oxygen, the flame has reduced the inside pressure. Air pressure then holds the bottle to your hand.



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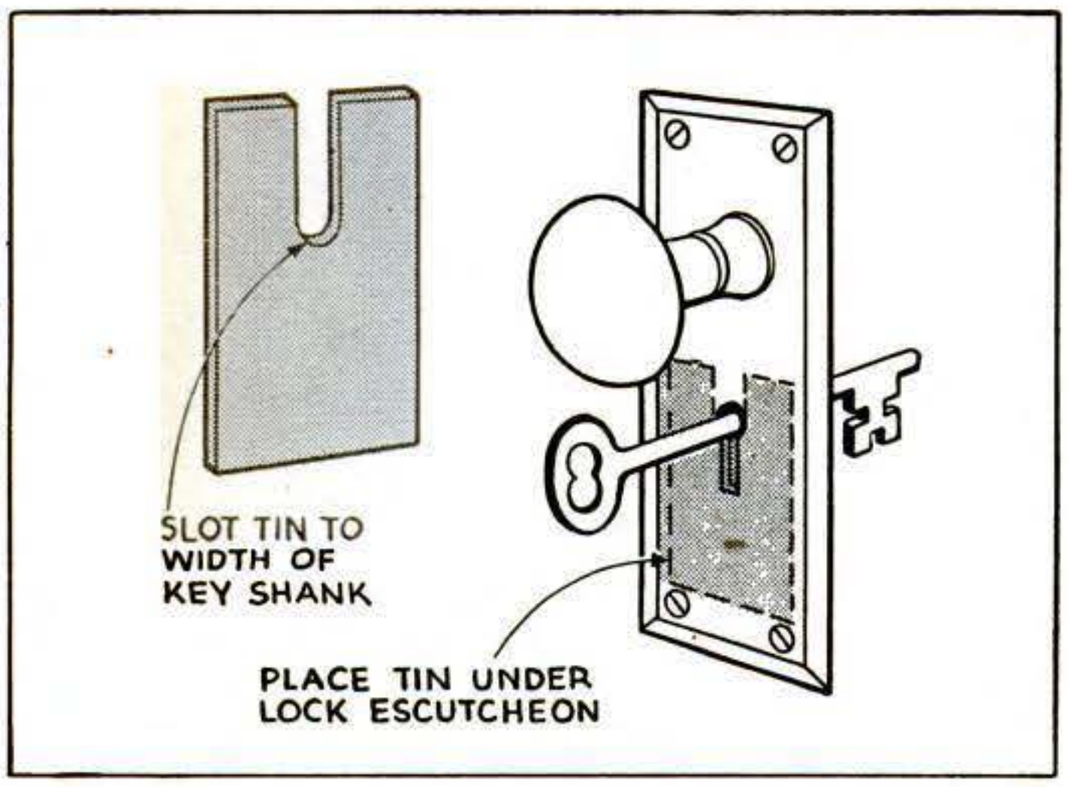
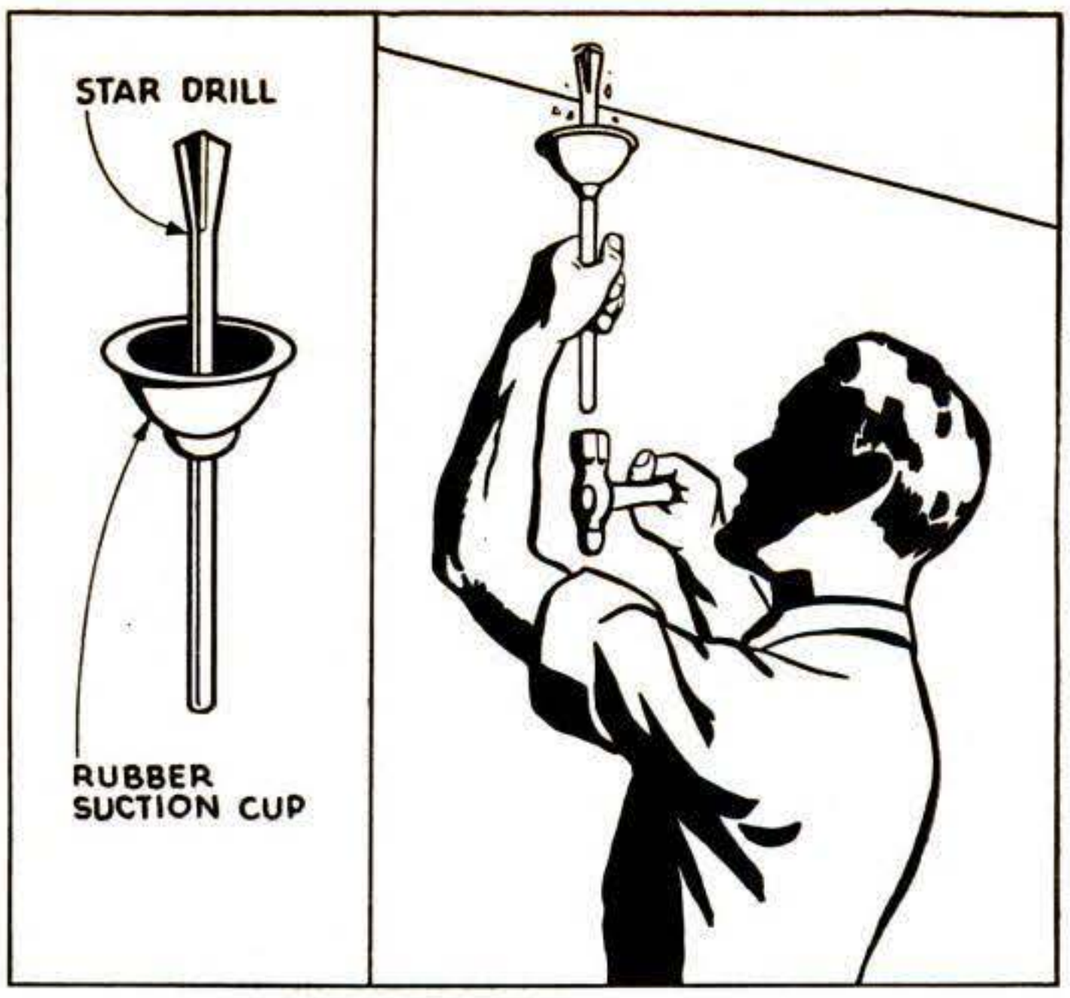
Tin Strip Keeps Key in Lock

MANY doors that are fitted with removable keys are, in practice, locked from only one side. In cases where any awkwardness might result from the key falling out or being removed by a child or thoughtless adult, you can equip the lock with a permanent key in the manner shown below. Cut a strip of tin to fit under the escutcheon plate of the lock, and snip out a long slot. Then insert the strip under the escutcheon so that it blocks the lock opening. This device also makes it impossible for a door to be opened by a skeleton key from the opposite side.—ROSCOE A. JOHNSON.

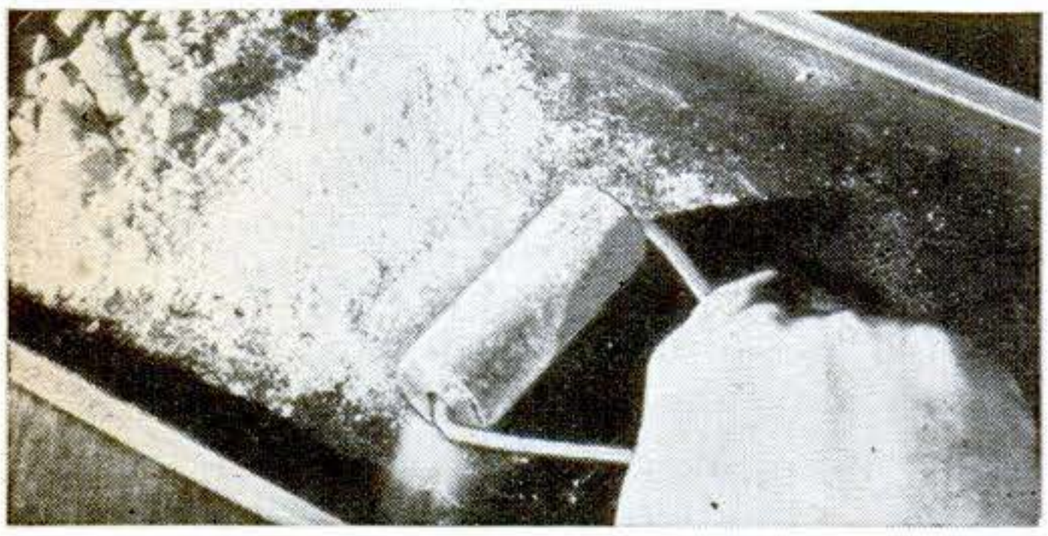




Chip Catcher for Overhead Drill

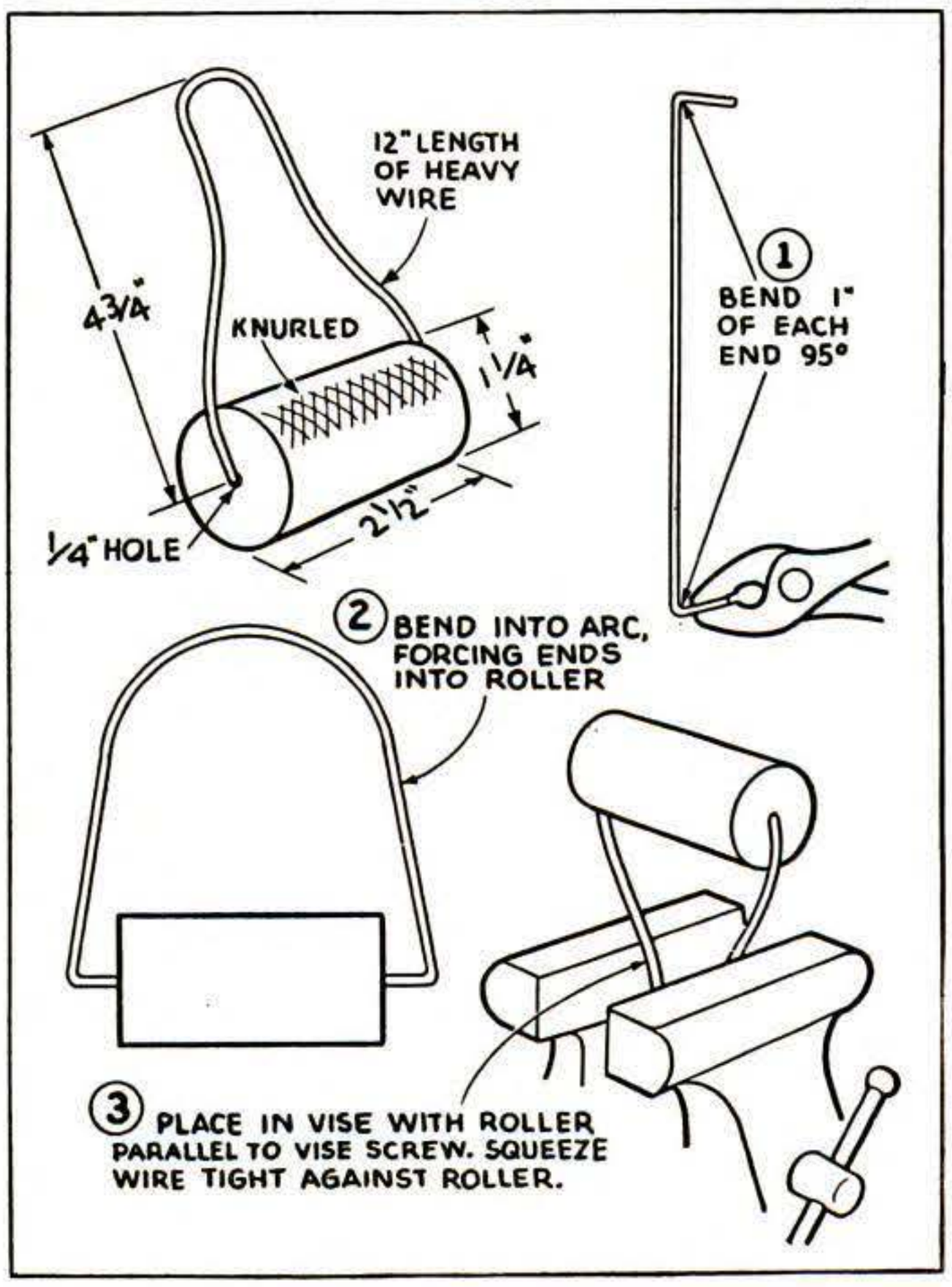
DRILLING plaster, cement, or brick directly overhead doesn't have to earn you a shower of dust and debris. To keep chunks knocked loose by the drill from pelting you and getting into your eyes, place a rubber suction cup of the type used on drain plungers over the shank of the star drill as above. Cut the hole through the rubber small enough to make a tight, slip-proof fit over the handle.—W. E. DANNEMAN.

Knurled Steel or Brass Roller Will Powder Chemical Crystals



SOME of the dry chemicals used in photography and laboratory work come in the form of large crystals that dissolve slowly and imperfectly unless first reduced to powder. Crushing them with mortar and pestle is a tedious business with any but very small quantities.

This roller crusher can be turned in a lathe in a few minutes; a short piece of brass or steel rod, knurled and drilled from both ends, forms the roller, and the handle is made of heavy-gauge wire shaped as shown at the right. Place the crystals on a metal tray to crush them.—WILL THOMAS.



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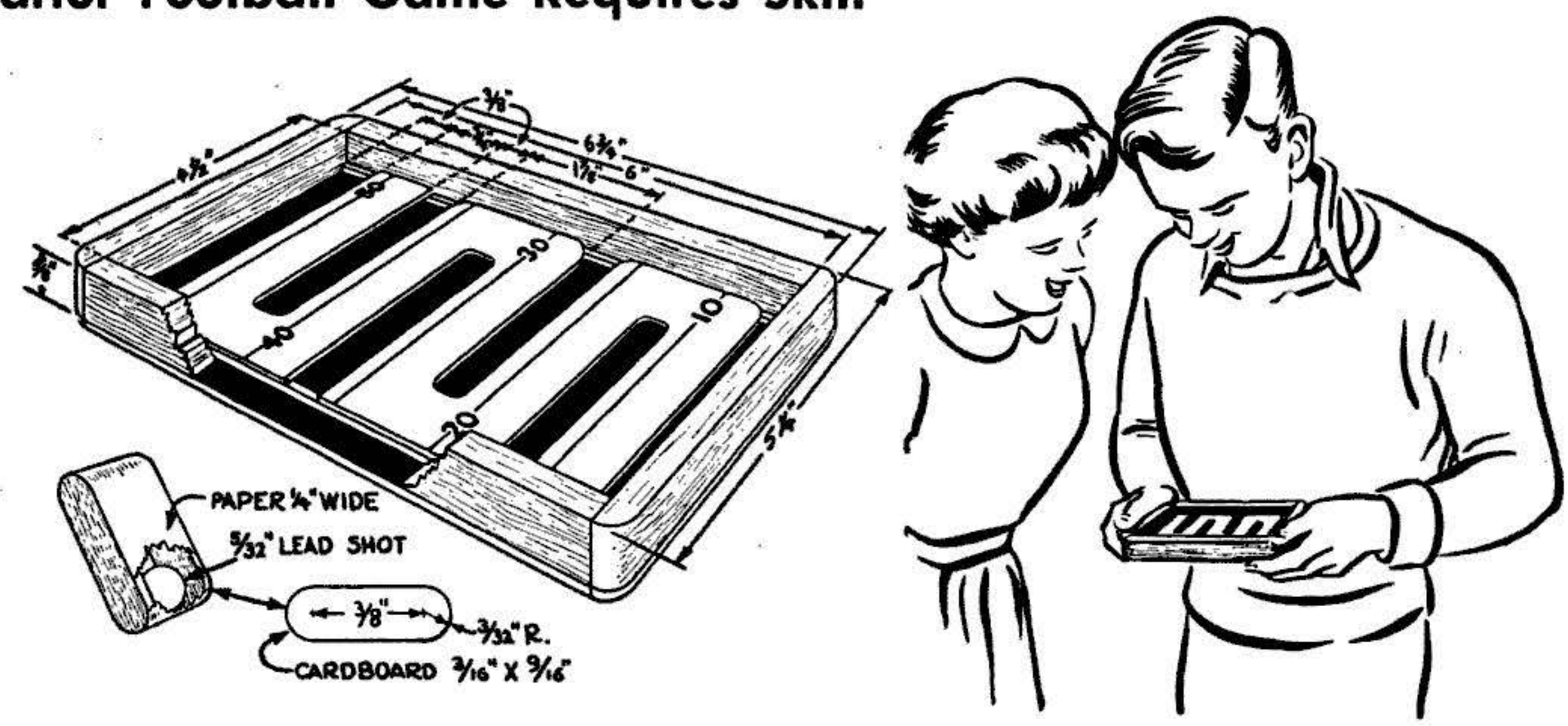
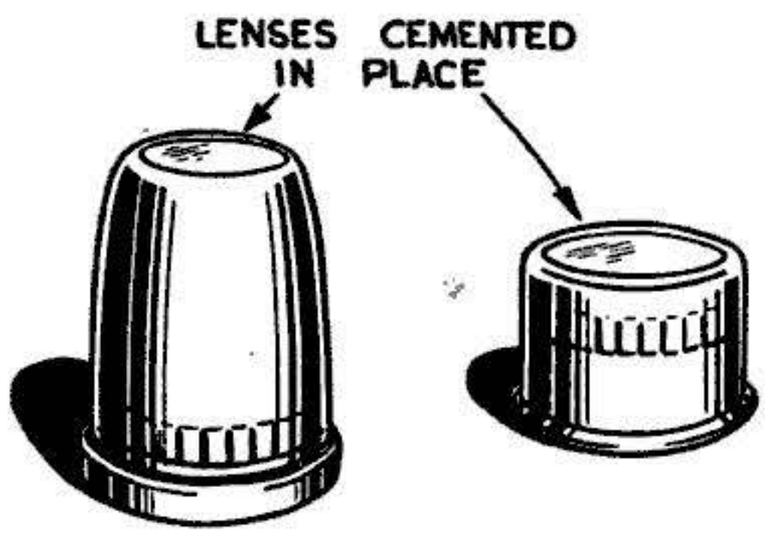
Parlor Football Game Requires Skill



EVERYBODY gets a seat on the 50-yard line at this football game. And tumbling the capsule "football" around the zig-zag playing field for a touchdown without letting it fall off (a "down") is not much easier than bucking the Army line.

Here's how the armchair football game is played. Tilting the board to make the capsule travel across the board and return to the starting point gives the six-point touchdown score, but if you make four downs, the capsule goes to your opponent. The quarter ends when each player has exhausted his four downs, and the high scorer at the end of four quarters wins.

To make the game, cut four wood strips to frame a 5¼" by 6¾" piece of 14-ply showcard board. Similar cardboard is used for the playing field, which runs back and forth across the board and is supported above it by ⅛" strips of cardboard. Edges should be smoothed with fine sandpaper, and surfaces coated with liquid floor wax. The capsule, made of six-ply showcard stock around which is glued a ¼" paper strip, contains a 5/32" lead shot.—FRANK SHORE.

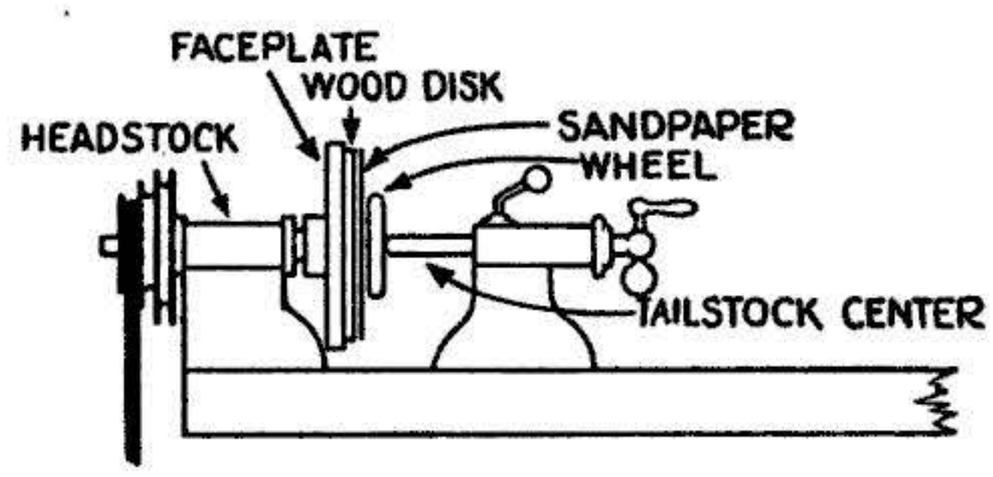


Bottle-Cap Jeweler's Loupe

IF YOU'VE envied the good-looking loupes jewelers use to magnify small work, you can make one of your own from a simple magnifying lens and a screw-type bottle cap. Cut a hole for the lens in the top, smooth the edge with a file, and paint dull black inside and out. The lens should be fastened in place by means of cellulose cement or a spring-wire snap wring.—G. E. HARRINGTON.

Shortcuts Speed Wheel Making

WITH a drill press and lathe, the job of making toy wheels can be put on a speedy production basis. A circle cutter in the drill press cuts the wheel blanks while the center bit simultaneously makes a perfectly centered hole for the axle. These blanks are then quickly centered and held in the lathe by using the tailstock to push them against a sandpaper disk cemented to a wood backing on the faceplate. Then the rims and recesses can be turned.—ALBERT W. STEIN.



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CHEMISTRY CONTRADICTS AN ADAGE

EMULSIONS Prove Oil and Water DO Mix

By KENNETH M. SWEZEY

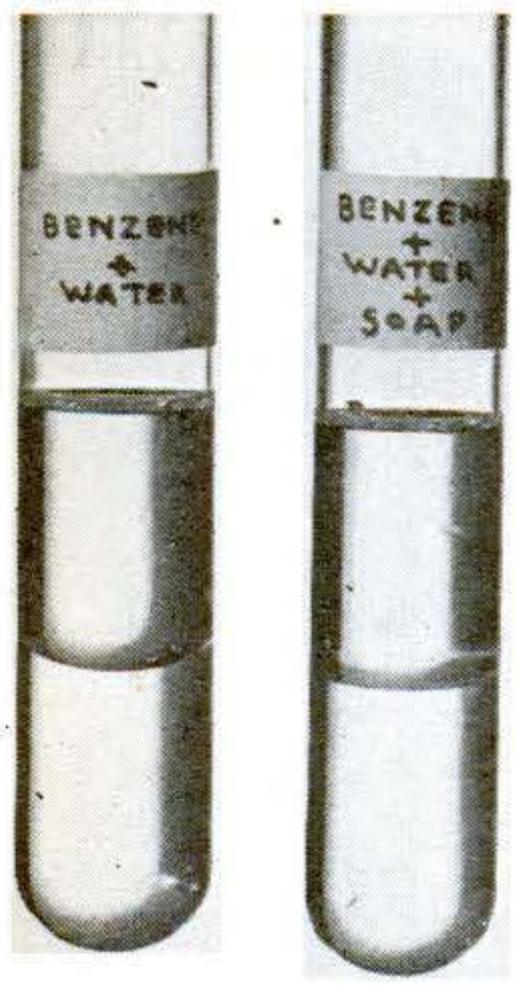
EVERY time we drink milk, eat eggs, or apply one of the new oil paints that can be thinned with water, we are dealing with a rather amazing contradiction. An old adage states with some emphasis and apparent authority that "oil and water won't mix." Yet in milk, eggs, emulsion paints, and various other products that combine oily with watery substances, nature on the one hand and the chemist on the other have employed chemical processes to disprove the old rule and perform the seemingly impossible.

Emulsions are the means by which it is done. Without these combinations of oily and watery substances, science, medicine, and industry would face serious handicaps; in fact, life could hardly go on. Fats and oil-like hydrocarbons are needed in the growth of animal and plant cells. Yet the main substances of these living cells are watery. Unable to dissolve the oils in water, nature uses emulsification. An almost perfect food is provided in milk, an emulsion of butter-fat globules in a water solution of lactose, mineral salts, and protein.

By means of emulsions, unpleasant castor and cod-liver oils can be made almost palatable, and foul-smelling oily substances are made odorless. Paints can be formulated to dry with a tough pigment-in-oil surface, although they are easily thinned with plain water. Modern agricultural sprays, salad dressings, cosmetics, lotions, drug preparations, and floor, furniture, and shoe polishes often owe their effectiveness to the know-how of the emulsion chemist.

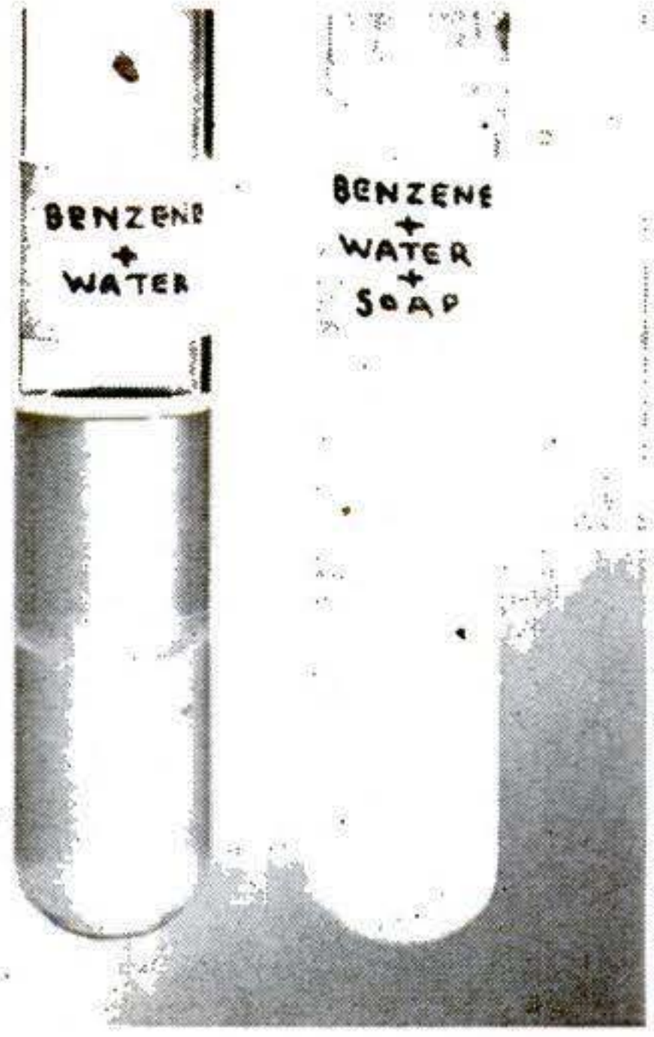
Fundamentally, an emulsion is a dispersion or scattering of tiny droplets of one liquid in another with which it will not form a solution. An emulsion usually can be produced by shaking or stirring the two liquids together. But unfortunately, an emulsion formed in this manner from two pure liquids quickly breaks up. Surface tension causes the globules to unite rapidly, and the drops then either rise or fall, separating the liquids into two layers.

In a test tube, shake together a little water and an equal amount of benzene, and you will see how this process works. After a few shakes, the two water-clear liquids will become a single milky solution. (The liquid seems uniform because the droplets are too small to be seen with the naked eye, and it is white because the droplets, acting like lenses, scatter the light.) Allow your emulsion to stand, and very quickly visible drops appear. These become larger and larger, the whiteness vanishes, and in a matter of seconds the liquids will have separated.



Shaken vigorously, water and benzene can be mixed, but a substance known as an emulsifying agent is needed to keep them from separating again. To show this, prepare test tubes as indicated at the left.

Shake both tubes several minutes, let them stand awhile, and you will get the results shown at the right. In one tube, the liquids separate. In the other, soap keeps them together as an emulsion.



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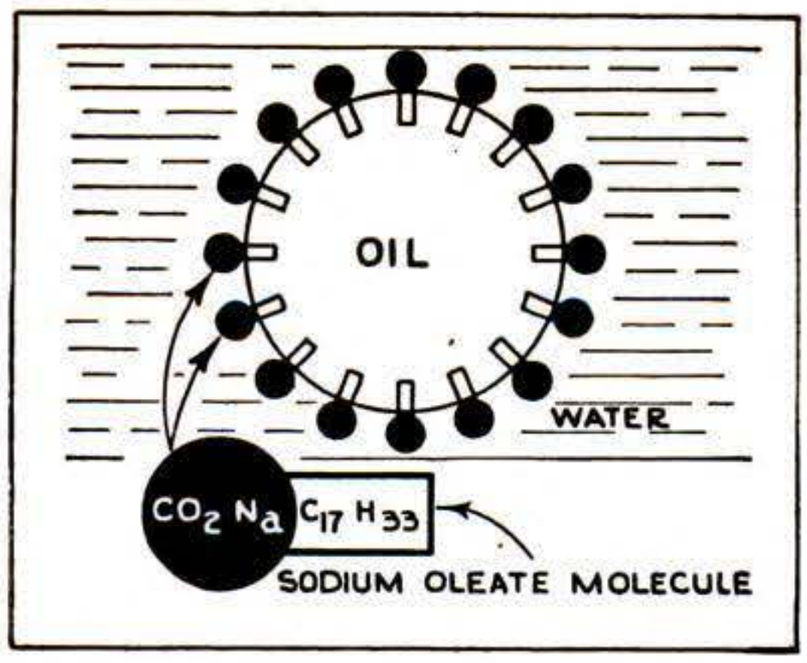

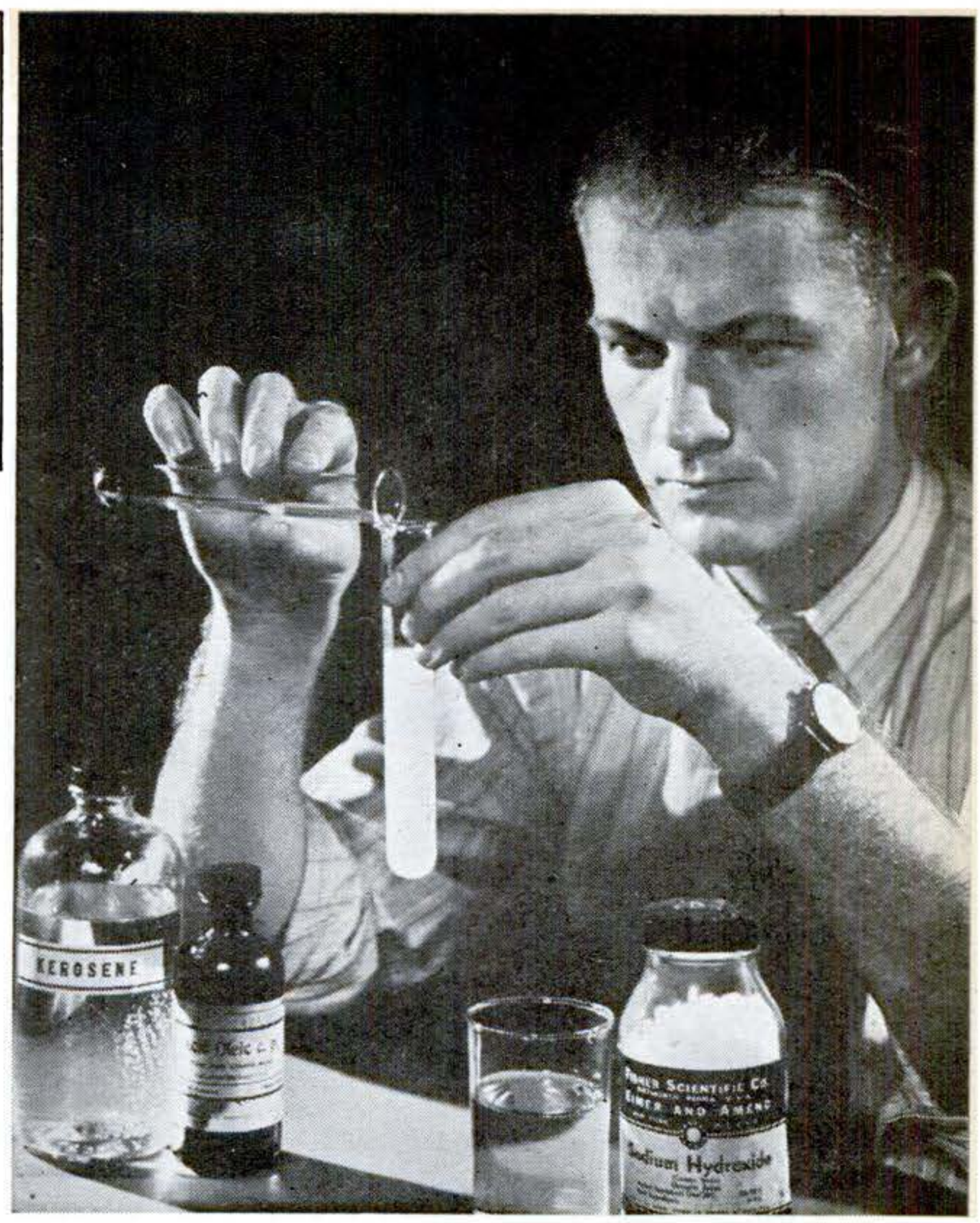

By one theory, an emulsifying agent such as the soap sodium oleate works as above, many molecules surrounding each oil globule and keeping it from coalescing with others of its kind. Right, sodium oleate is produced and an emulsion forms spontaneously when you add oleic acid to an oil, sodium hydroxide to water, and mix the two.

To keep such an emulsion from breaking up requires all the magic of the chemist, for a stable emulsion never can be formed from two pure liquids alone. He must add a small quantity of a third substance, known as an emulsifying agent. Since there are hundreds of possible substances that can serve as agents, each having its own special merits, the chemist must know how to select the best one for the emulsion he requires.

Plain soap (sodium stearate or sodium oleate) is a common emulsifying agent. Repeat the previous water-benzene experiment after first dissolving a few shavings of toilet soap in the water. In this case, intermittent shaking, with a pause of 15 sec. after every few shakes, often will produce emulsification faster than continuous shaking. After shaking intermittently for 5 min., observe your emulsion and you will see that it looks the same as the one you produced with only water and benzene.

But this time the oil and water will separate only slightly, if at all. However, after long standing, this emulsion may appear thicker and whiter at the top. This effect is called *creaming* because of its similarity to cream rising on milk. It does not indicate *breaking*, the permanent separation of the oil from the water. When creaming occurs, a slight shaking will make the emulsion uniform again.

If you add a few grains of sodium hydroxide to 10 ml. of water in one test tube, a little oleic acid to a similar amount of oil or benzene in another, and then pour the contents of the latter tube into the first, the soap sodium oleate will be produced. In this case, an emulsion that can be kept stable with little shaking forms spontaneously.

Besides sodium and potassium soaps, emulsifying agents include such substances as egg yolk, gelatin, gum arabic, gum acacia, sulphonated oils, aluminum and zinc stearates, and such finely powdered substances as mustard, clay, silica, and carbon black.

Why emulsifying agents perform the work they do is imperfectly understood, but they usually reduce the tension between the two liquids and sometimes they set up an actual physical barrier that prevents the globules from joining.

In the case of soaps and synthetic organic compounds, the protective effect is believed to be due to the molecular structure. One end of each molecule of such substances is soluble in oil and the other in water. When placed in a mixture of oil and water, these molecules tend to orient themselves so that their oil-soluble ends are turned toward the

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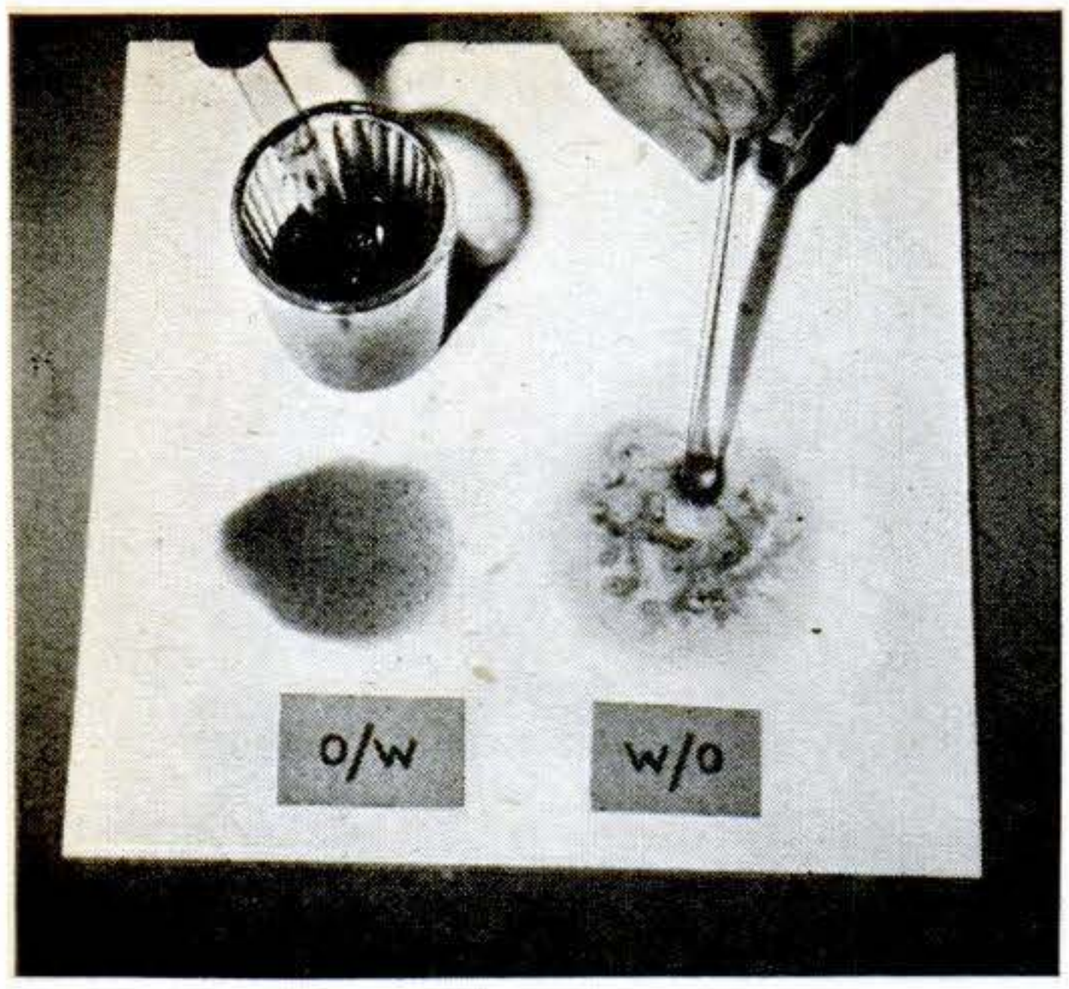
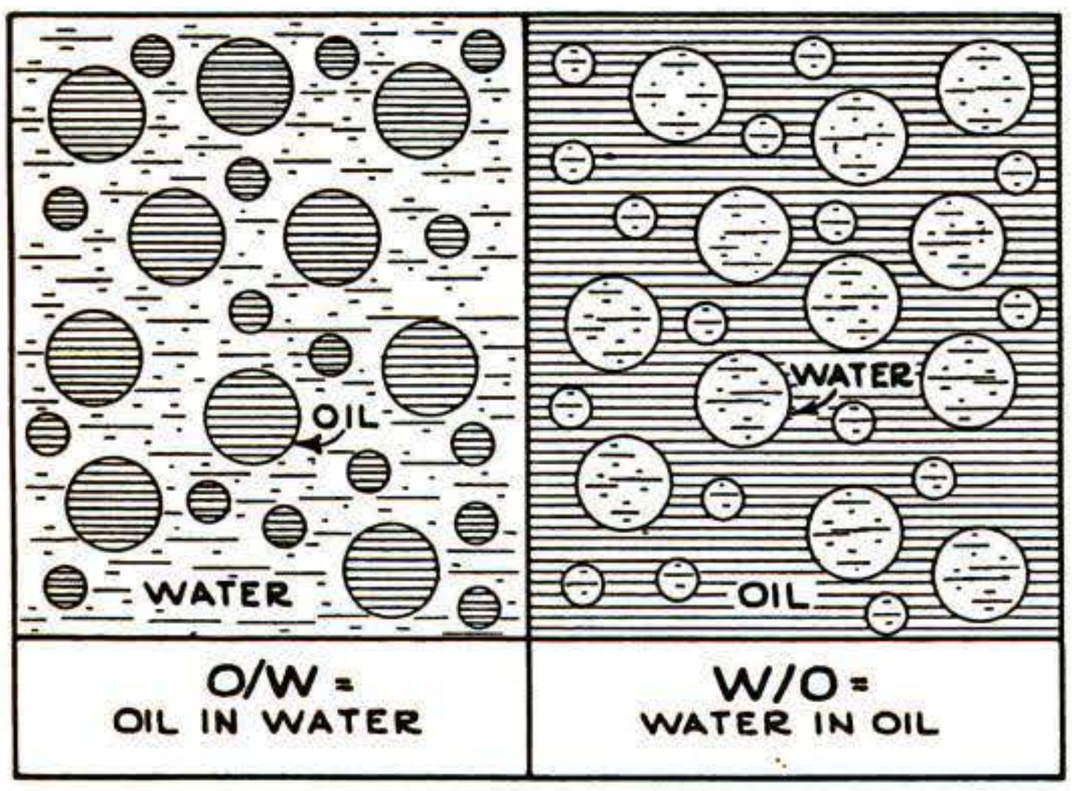
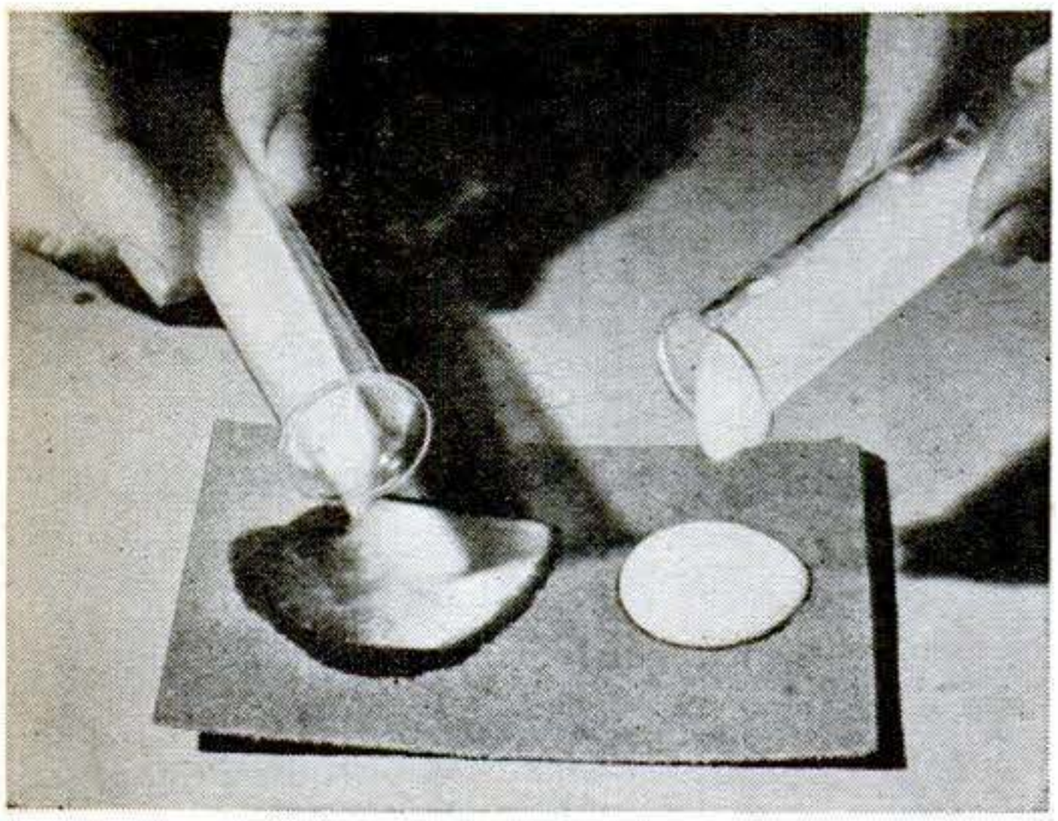




Emulsions consist either of oil in water or water in oil, abbreviated as above, and a test usually is required to determine the type. At the top, a water-soluble dye was added to a sample of each type as a test. Because the external phase of the one at the left is water, the dye gives à uniform color, but since the water in the one at the right is surrounded by oil it is colored only in spots.

To thin or thicken an emulsion you must know its type to produce the desired result. Below, water thins (left) and oil thickens an O/W emulsion.



oil and their water-soluble ends toward the water. By this action, each suspended globule is finally encased in a sheath of molecules that at once bind it to the surrounding liquid and at the same time prevent it from coalescing with other globules of its own kind.

All emulsions consist of two *phases:* an external or continuous phase, and an internal phase which consists of millions of separate tiny droplets. (In physical chemistry, a phase is defined as a homogeneous, physically distinct portion of matter in a nonhomogeneous system.) Depending upon the emulsifying agent and sometimes upon the conditions of mixing, an emulsion may consist of oil in water or of water in oil. In technical literature, an oil in water emulsion is abbreviated O/W, while a water in oil emulsion is W/O.

The benzene-water emulsions you have just made, milk, mayonnaise, and most emulsion paints are of the oil in water type. Butter, oleomargarine, and some lubricating greases are water in oil. Often the two types of emulsion may look alike and tests must be made to determine which is which.

One test is to add to a sample of the emulsion a few drops of a dye that is soluble only in oil or only in water. For example, add a water-soluble dye to a little of your benzene-water emulsion and stir it gently. The sample will be colored uniformly, indicating that the continuous or external phase of the emulsion is water. If the emulsion were water in oil, the water-soluble dye could not color it continuously. (You can make a W/O emulsion for this comparison by adding a little calcium or magnesium oleate to the benzene, instead of soap to the water, before emulsification.)

In order to thin or thicken any emulsion, you must first know its type, for if the wrong phase is added you will produce the opposite effect from what you wish. To thin a given emulsion, you must add more of the external phase. To thicken it, you must add more of the internal phase. You can show this with your benzene in water emulsion. Add water to it and it flows more freely. Add benzene, with additional shaking, and it finally will become so thick that it cannot be poured.

Oddly enough, the internal phase of an emulsion may have considerably greater volume than the external. Mayonnaise is such an emulsion, of the O/W type, in which a large volume of oil is contained inside a

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Above are the ingredients of mayonnaise, an O/W type emulsion. A large amount of the oil is emulsified in vinegar, with egg yolk as the main agent.

Left, add the oil slowly to the other ingredients with steady beating and you will wind up with a mayonnaise that is just as good as any you buy.

Right, certain substances nullify the effect of an emulsifying agent. Here, dilute hydrochloric acid breaks soap molecules and separates an emulsion.

volume of water that is comparatively small.

Making a sample of palatable mayonnaise affords a good demonstration of some of the problems of commercial emulsion making. In this foodstuff, salad oil (cottonseed or corn oils both are suitable) forms the internal phase, vinegar or lemon juice the external phase, while egg yolk, powdered mustard, and paprika jointly make up the emulsifying agent. Salt must be added as seasoning, but it tends to destroy, rather than help, the emulsification.

Put an egg yolk, ½ teaspoon salt, ¼ teaspoon dry mustard, and ⅛ teaspoon paprika into a small bowl and beat thoroughly. Add 1 tablespoon of vinegar and beat again. Very gradually, beat in 8 oz. (1 cup) of salad oil, adding only ½ teaspoon at a time for the first 2 oz. Then add ½ oz. at a time. By the time you have added all the oil, you will have produced a first rate mayonnaise.

By adding substances that break down the protective effect of emulsifying agents, or by adding agents that produce the opposite type of emulsion, you usually can break, or separate, an emulsion into its constituents. You can demonstrate this by adding a little dilute hydrochloric acid to your benzene in water emulsion. As the acid breaks down the soap molecules, they lose their emulsifying power and the oil and water components quickly separate.

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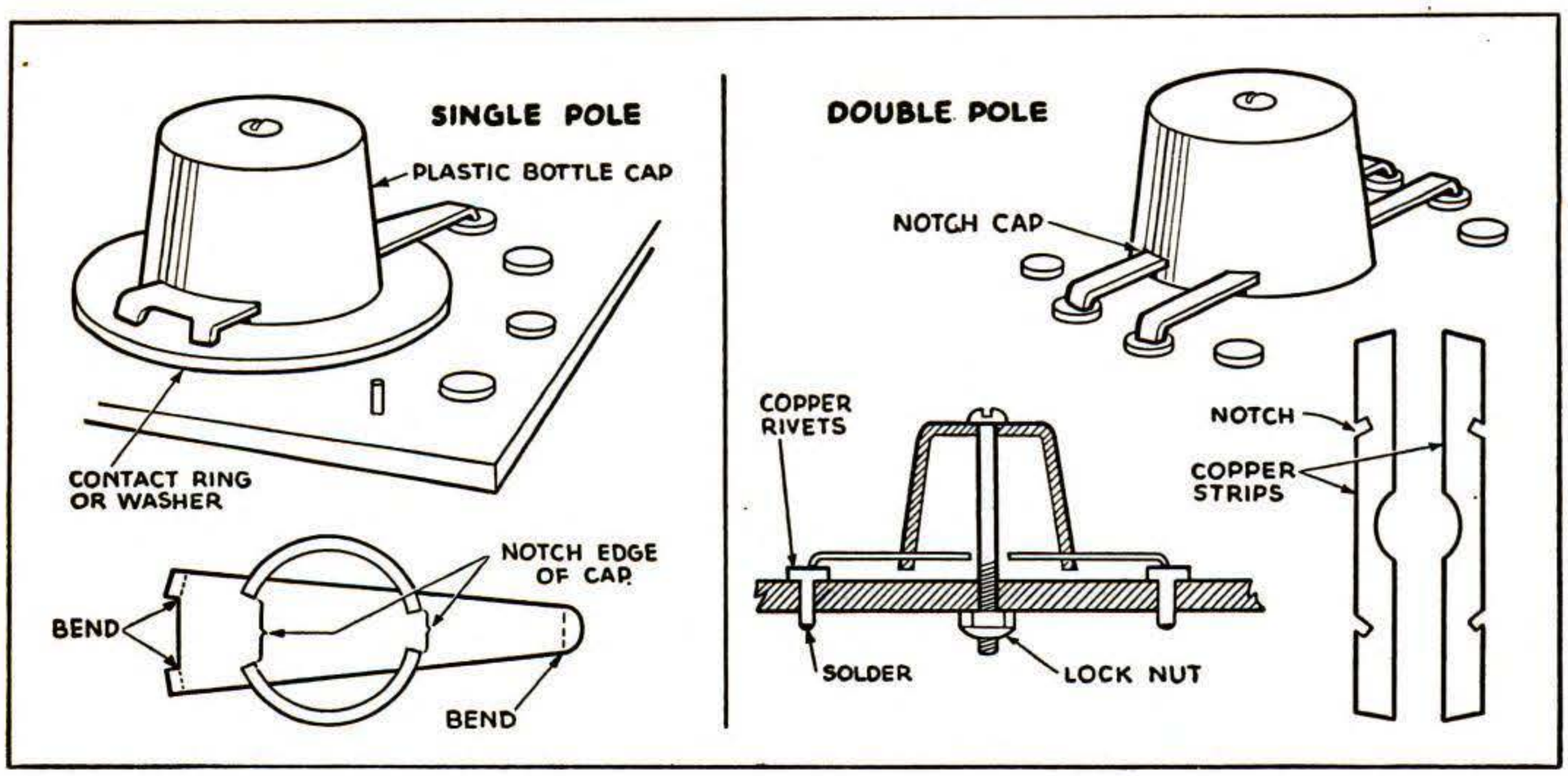
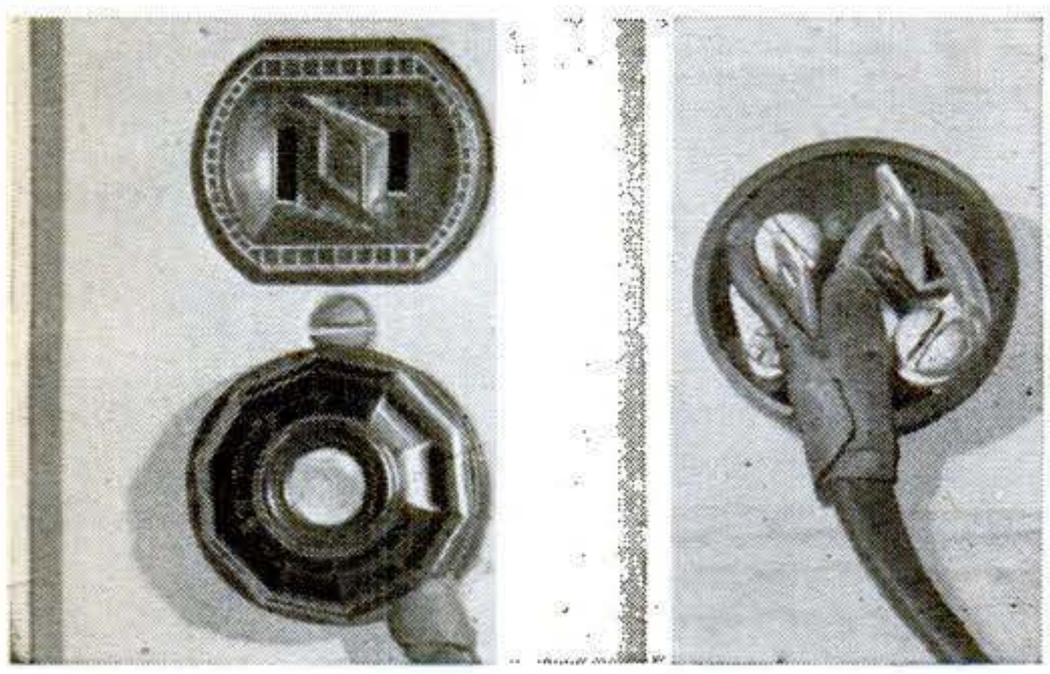
Switches for Variety of Uses Built Around Plastic Bottle Caps



SINGLE or double-pole switches with almost any number or combination of contact points can be made from discarded bottle caps and scraps of metal. Although they involve practically no expense, switches of this type can add to the appearance of experimental wiring setups. Modern plastic caps are attractively designed and come in a variety of colors and sizes. File a notch in the bottom of each cap, and also notch the blades as shown so that they cannot slip lengthwise. Make a temporary assembly and mark off the proper blade length to allow for a bend at the tip.—JOHN D. ADAMS.

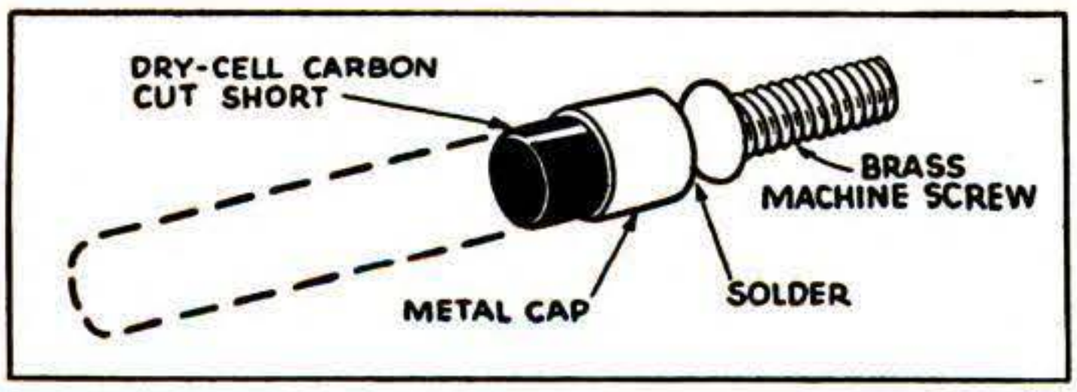


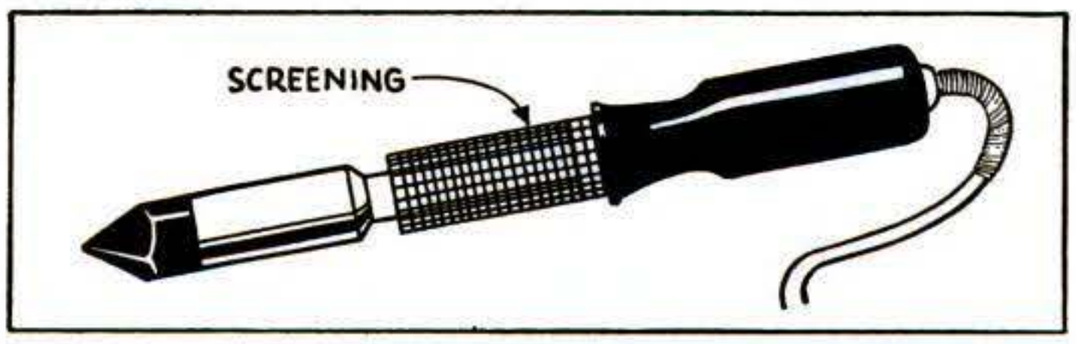
Flattening an Electric Plug

WHEN lamp cords are plugged into outlets behind furniture that must be moved for cleaning, the cord is likely to be disturbed and the insulation frayed. A satisfactory flat plug may be improvised by filing a rounded notch in the wall of a common one. Tape the cord where it touches the plug, and close the unused cord hole with a small cork or sealing wax.

Contacts from Flashlight Cells

HARD-TO-FIND small carbon contacts for relays and the like may be made by removing the carbon rod from a flashlight cell and soldering its metal cap to the flattened head of a brass screw. The carbon may then be cut to size.—G. A. GAULD.





Wire Screen Cools Iron Handle

IN CONSTANT use, soldering iron handles often get uncomfortably warm. A piece of copper screening around the shank near the handle radiates heat away from the hand. Keep the screen away from the tip or it will dissipate too much useful heat.

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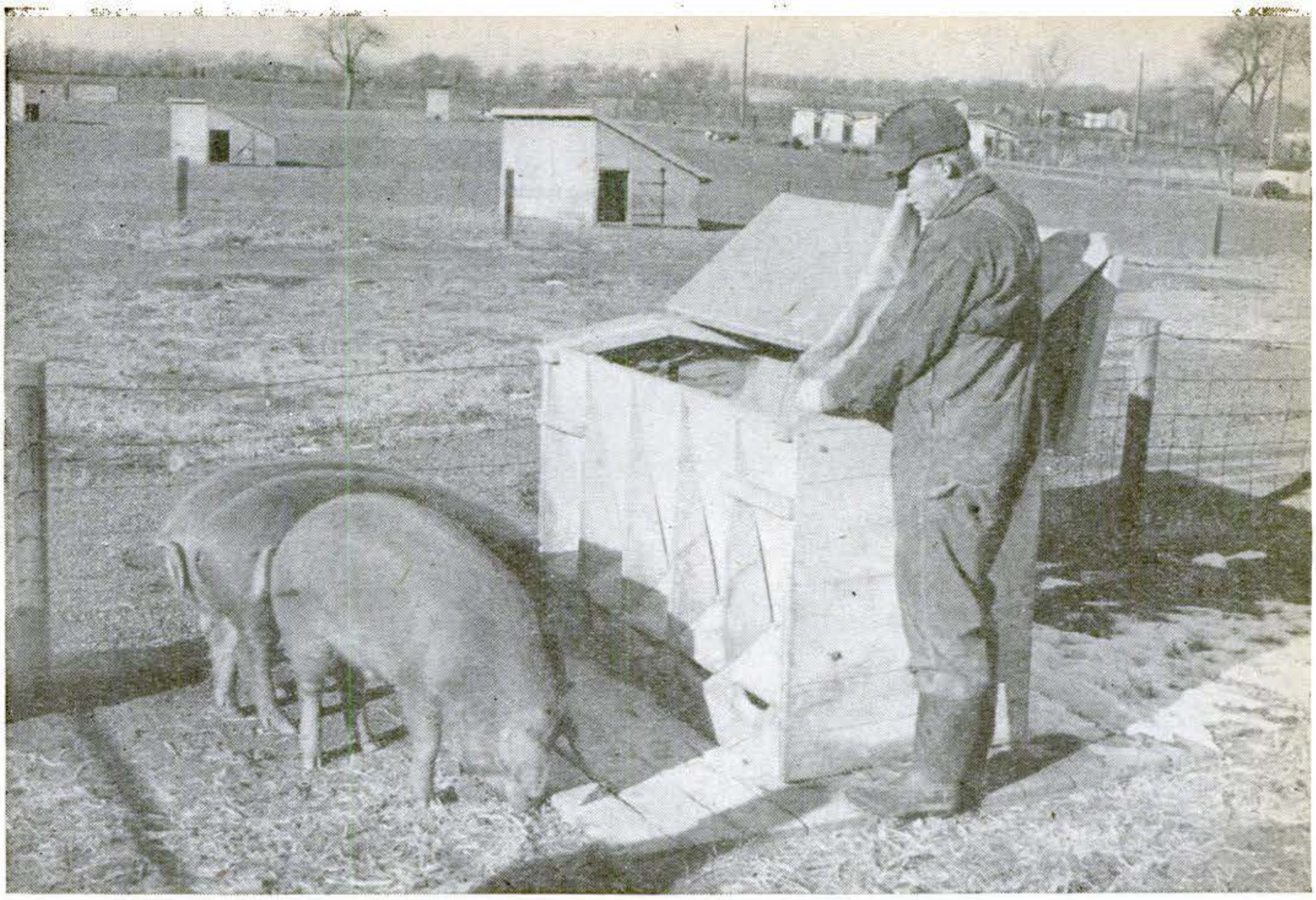

Feed for several days can be put in the hopper of this self-feeder, and a short inspection each day to see that it is working properly will be sufficient until time for refilling. Because the feeder can be moved to clean ground when necessary, hogs fed by it are healthier and fatter.

Hog Feeders LESSEN FARM CHORES

By E. W. LEHMANN

FARMERS who fatten their hogs for market have less waste and less expense and produce healthier and fatter stock when they use some type of self-feeder. A great deal of time is saved in care, too, if the hopper is large enough to hold a supply for several days, for it will require only perfunctory inspection once a day to see that all is working as it should be.

While commercial feeders are available, a homemade feeder will give good results if carefully constructed. It should be provided with a top as a protection against weather and should be light enough for moving once in a while to a fresh site. A large feeder may be mounted on skids for moving by team or tractor. Sites should be well drained or concreted to prevent spoilage. Theft by rats, squirrels, birds, and the like rarely presents a problem.

The plan for the feeder shown was developed at the University of Illinois Agricultural Experiment Station and has been found dependable for feeding shelled corn and ground grain. It has a capacity of about 25 bu. and has troughs for feeding on both sides. Partitions keep the animals separated. A divider down the center of the hopper equalizes the flow of feed to the troughs on both sides. The size has been found large enough to accommodate as many as 30 or 40 hogs.

Feed is poured in under the hinged hopper top after the agitator arms have been adjusted so they will be moved by the animals themselves as they feed. They prevent bridging and accelerate the flow of feed to the troughs. The throats on the

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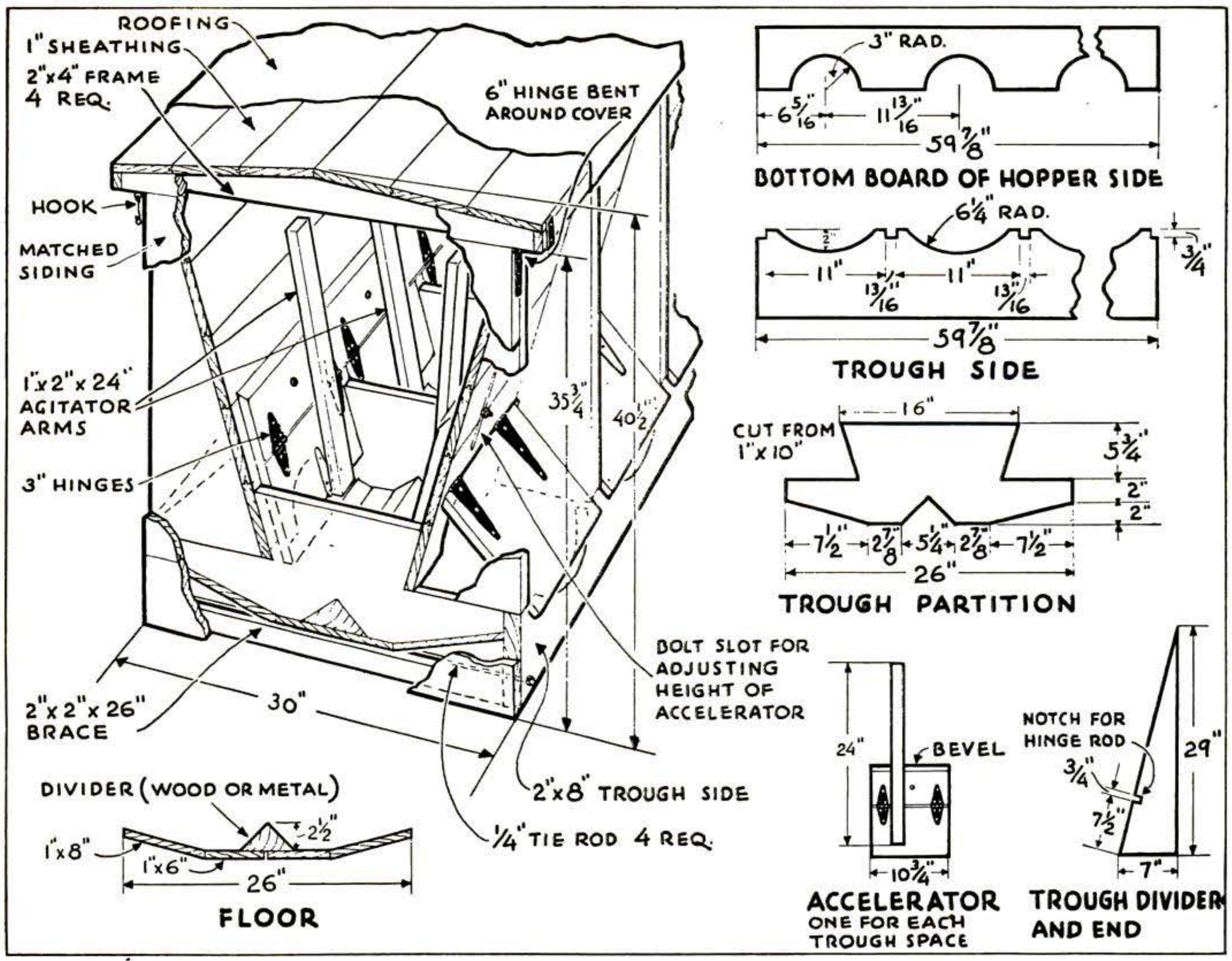

hopper side of the troughs are wide enough to permit the feed to work down easily.

Hinged doors over the individual troughs are lifted by the feeding hogs and give protection against weather when the feeder is not in use. The hinge-pin end of the strap hinges used works on a long hinge rod supported in the ends and in notches in the triangular uprights between troughs. As the animals nose into the hopper throats for more food, the separately hinged throat covers are pushed upward to work the agitator arms hinged in turn to them.

Hogs are usually more successfully fed by self-feeders than any other livestock. They have excellent appetites, eat large quantities without injury, and are not easily thrown off their feed.

It is usually found best to have two or more feeders for the stock. A separate feeder can then be used for shell corn, another for ground feed, and a third for supplemental feeds.

Even the best-designed and best-built self-feeders require some attention. They should therefore be inspected at regular intervals to see that the supply of feed is adequate and that it is feeding down properly without undue waste. A good practice with the feeder shown, and with any other automatic equipment where livestock is concerned, is to give it some personal attention each day as a check on its operation.

Double Snow Shovel Cuts Time in Scraping Wide Sidewalks

Two snow shovels bolted together will clean a wider path than one and in just about the same time. Remove the handles first, and then overlap the shovels 1″ or 2″ and drill and bolt them together. Next, bolt a handle on near each end and join them with a stout crossbar bolted near the top. A length of 1″ by 2″ oak rounded slightly is excellent. If additional support is needed, a similar piece of oak may be bolted on the back of the blades.

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Cellar Gardens Thrive in Winter Under Fluorescent Lights

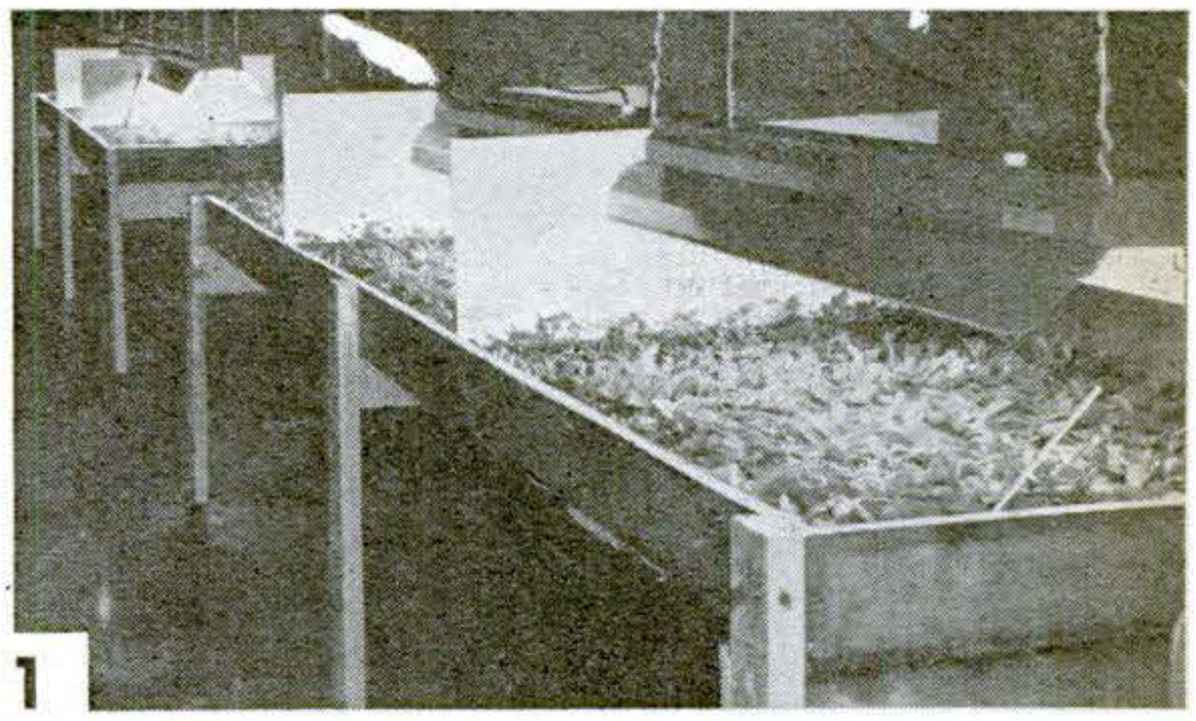
CUTTINGS and seedlings can be grown with little attention or fuss in your basement this winter for an early start on your home garden. You need no greenhouse or other expensive equipment. An ordinary fluorescent bulb can be your "sunlight."

The method, as reported by V. T. Stoutemyer and Albert W. Close, of the Bureau of Plant Industry, was developed at the U. S. Plant Introduction Garden at Glenn Dale, Md. Cases of varying construction were used, and the only light employed was that from 30- and 40-watt fluorescent bulbs.

Three types are shown in the photos—an open table in Fig. 1, a hinged-top frame lighted by two 40-watt fluorescents for each section in Fig. 2, and a small side-hinged frame using one 30-watt lamp in Fig. 3. The rooting medium is vermiculite, a mica-bearing mineral gravel expanded by heat. It is available at most building-supply dealers as concrete aggregate or, somewhat coarser, as house insulation.

A frame suitable for home use is shown in the drawing. It should be built of some decay-resisting wood such as cypress or redwood and covered with waterproof composition board. An air space is left below a false bottom of wire screening fine enough to hold the gravel, and an air space is provided above the lamp to prevent overheating.

Where the basement temperature is likely to go below about 72 deg. on occasion, a socket should be provided in the bottom air space and a small heating unit used with a chicken-brooder or soil-heating thermostat to keep the temperature at 72 to 75 deg. White or pink fluorescents are preferred, but daylight lamps will serve.



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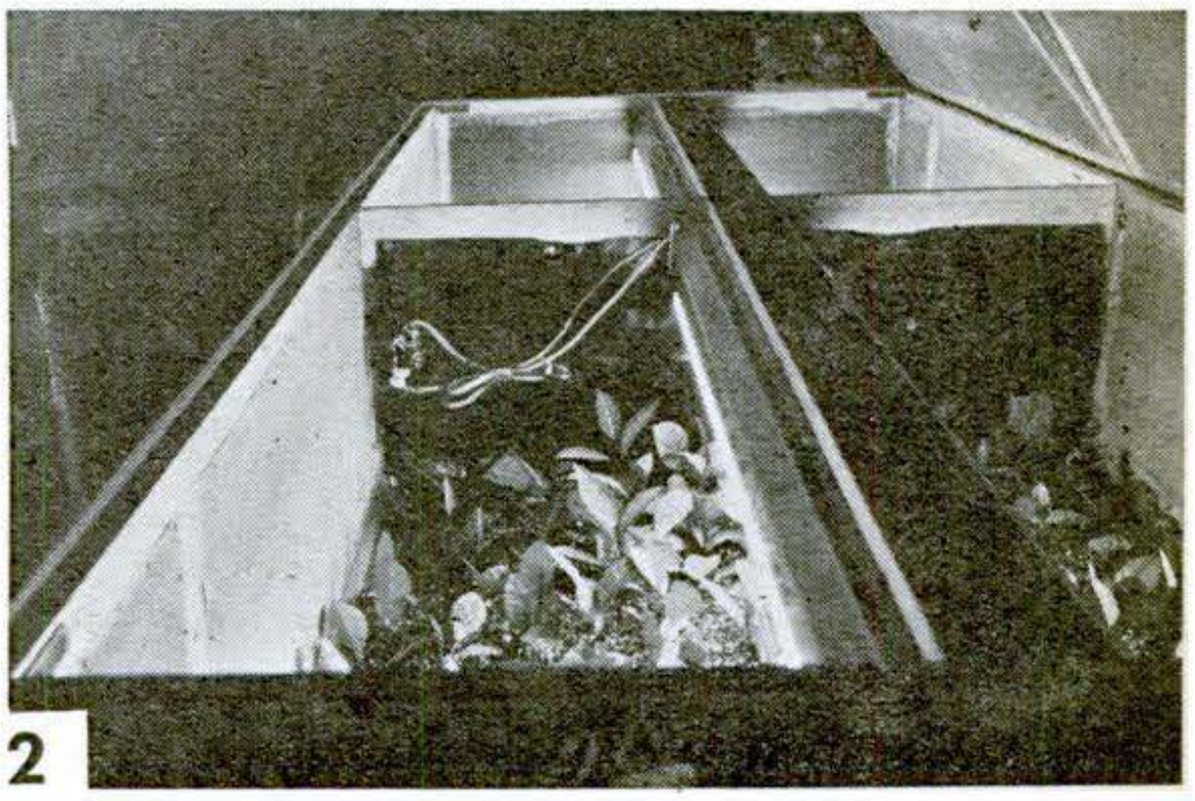

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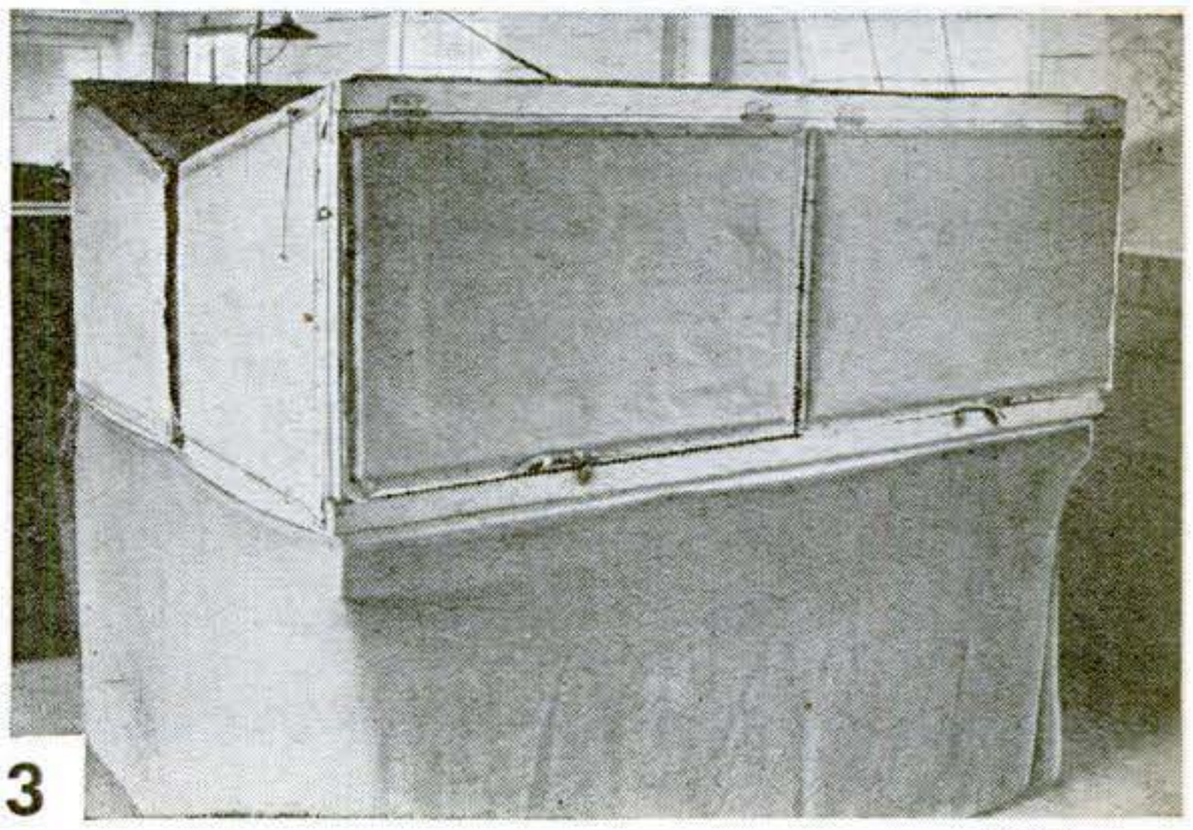
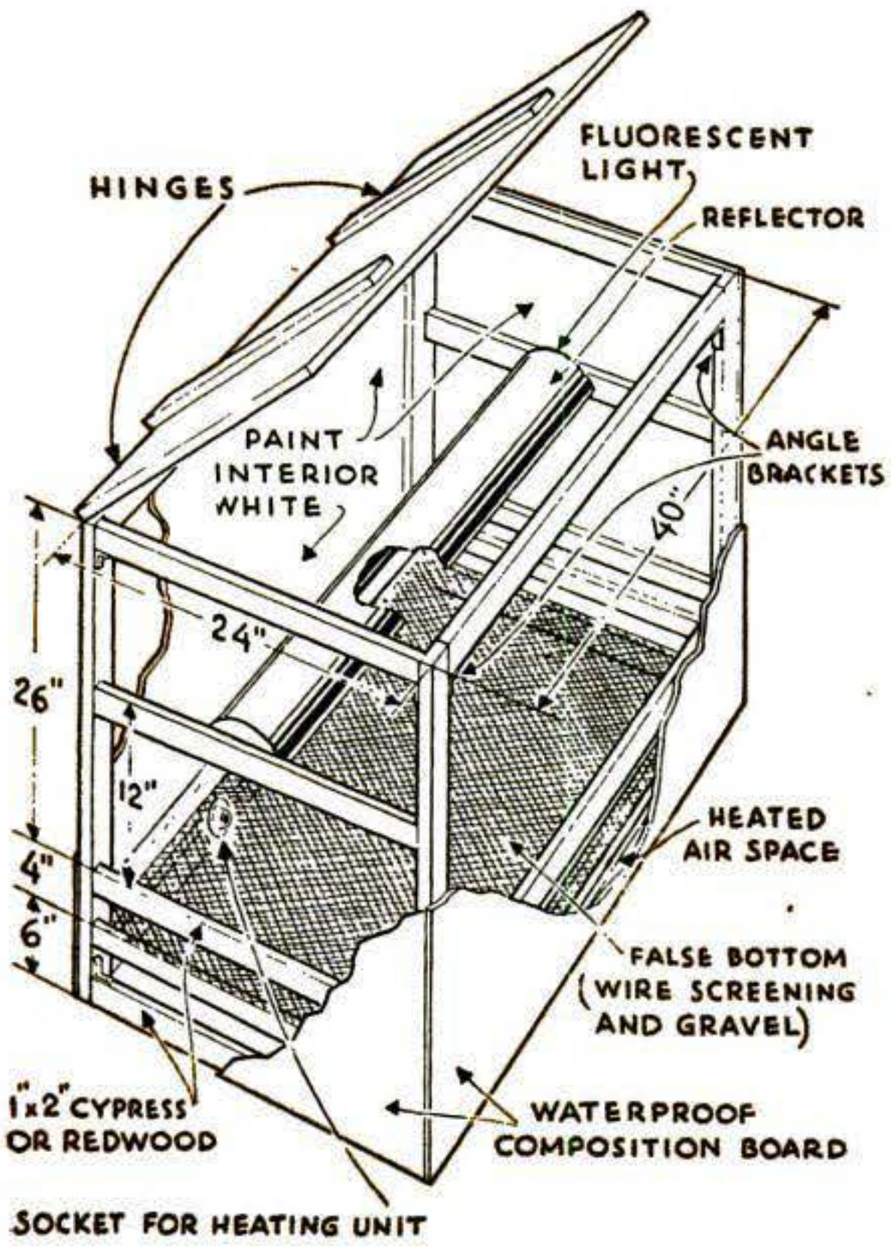


3

The cellar "greenhouse" below was designed for use with one 30-watt fluorescent lamp, which may be left lit continuously.



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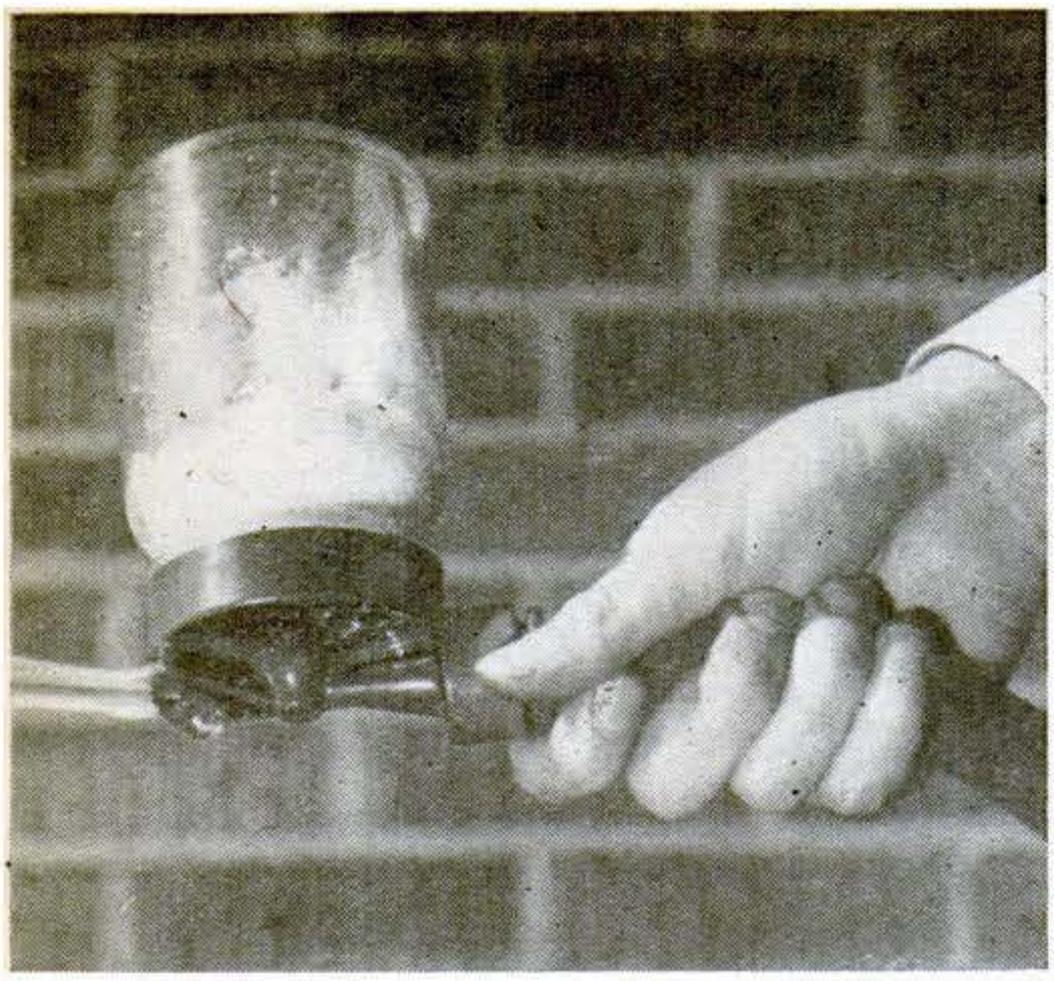
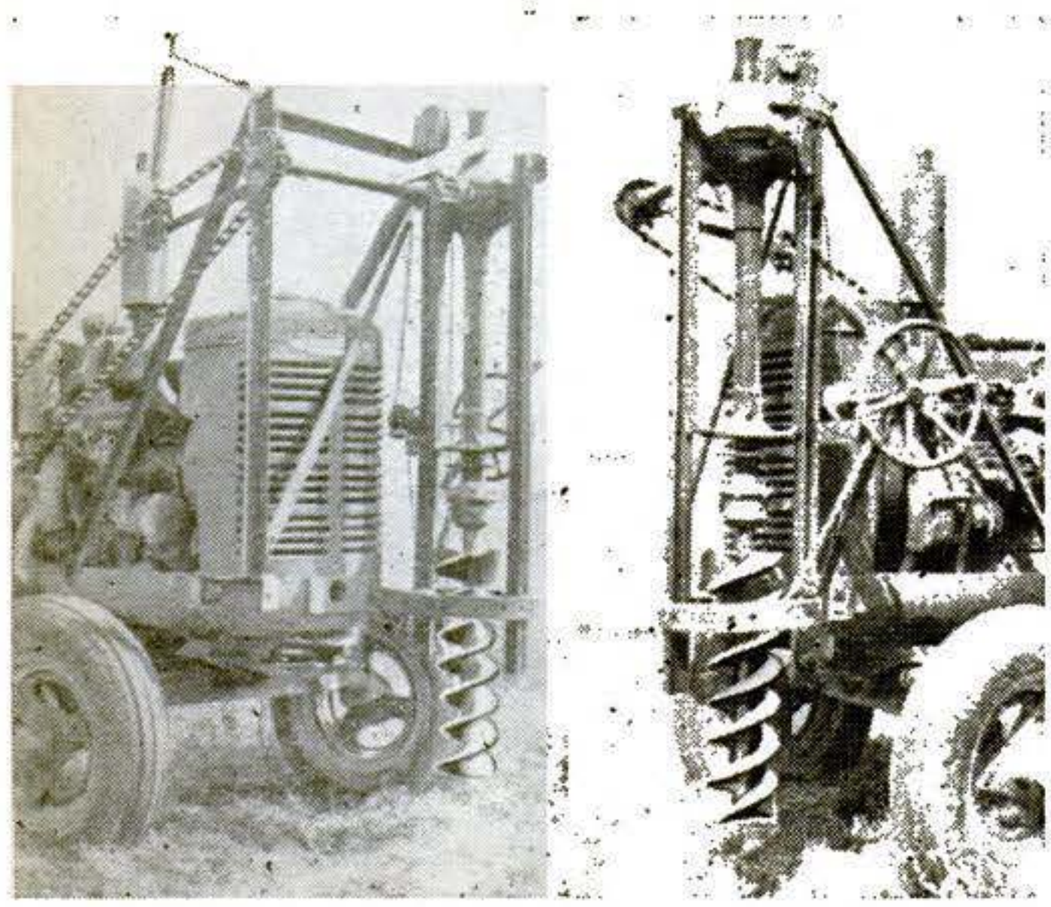


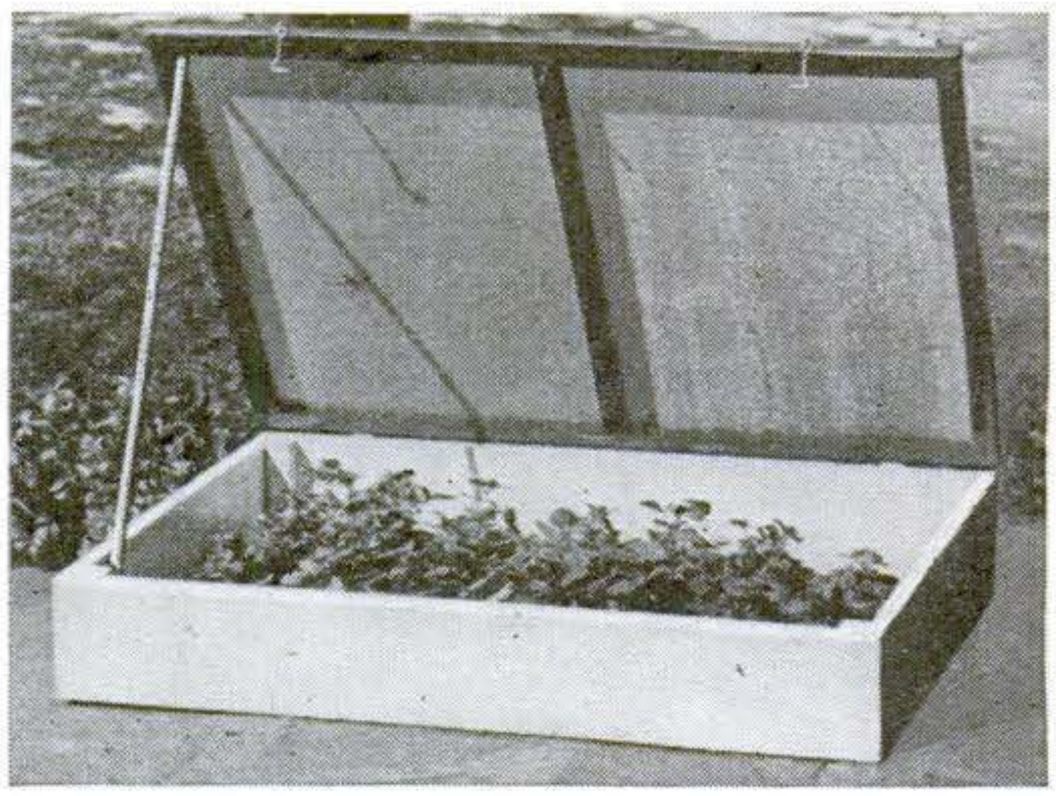
FERTILIZING AND WATERING plants or a lawn in one operation is possible with a unit that attaches to a hose as above. Using powdered sulphate of ammonia or nitrate of soda, the sprayer mixes and sprays the chemical by utilizing water pressure, the chemicals being so thoroughly mixed with water that there is little danger of burning the plants. The manufacturer is the Charles H. Lilly Co., of Seattle, Wash.

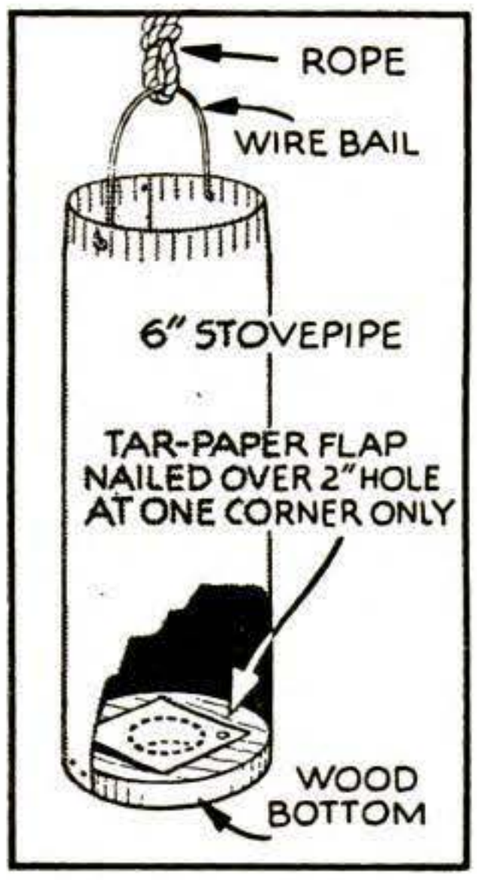
POSTHOLES ARE DUG in 15 to 45 seconds on the farm of Glenn Lindberg at Cut Bank, Mont., with a posthole digger built in large part of an old auto differential. Power for the augur is transmitted by a chain, kept taut by a spring-tensioned sprocket as the digging head slides into the earth between vertical rails. Holes dug by the machine are 6″ in diameter and 33″ deep. Power for operating the screw is taken from the engine of a tractor.



FOR EASIER FARMING

COLD FRAMES for home gardeners made in a 2′ by 3′ size by Hahn and Rapetto, of Paterson, N. J., use plastic instead of glass to pass sunshine to the seedlings. The covering is a Celanese product, plastic-mesh Vimlite. In this material, a plastic mesh of about the size of household screening reinforces the solid plastic coating.





ARTESIAN WELLS that fail to flow spontaneously are frequently so deep that they require a special pump. A bucket that will descend through the small-diameter hole of such a well can be made of an 18″ length of 6″ stovepipe to serve until the pump can be installed. Nail in a disk of ¾″ pine or similar stock for the bottom and attach a bail for the rope.

Since the bucket can't be tilted in the narrow well, water must be admitted through a leakproof valve, which may be a 2″ hole in the bottom covered by a square of tar paper nailed at one corner. The flap will rise to let water in as the bucket sinks; the force of the water will close it as the bucket is drawn.—R. T. De Forest

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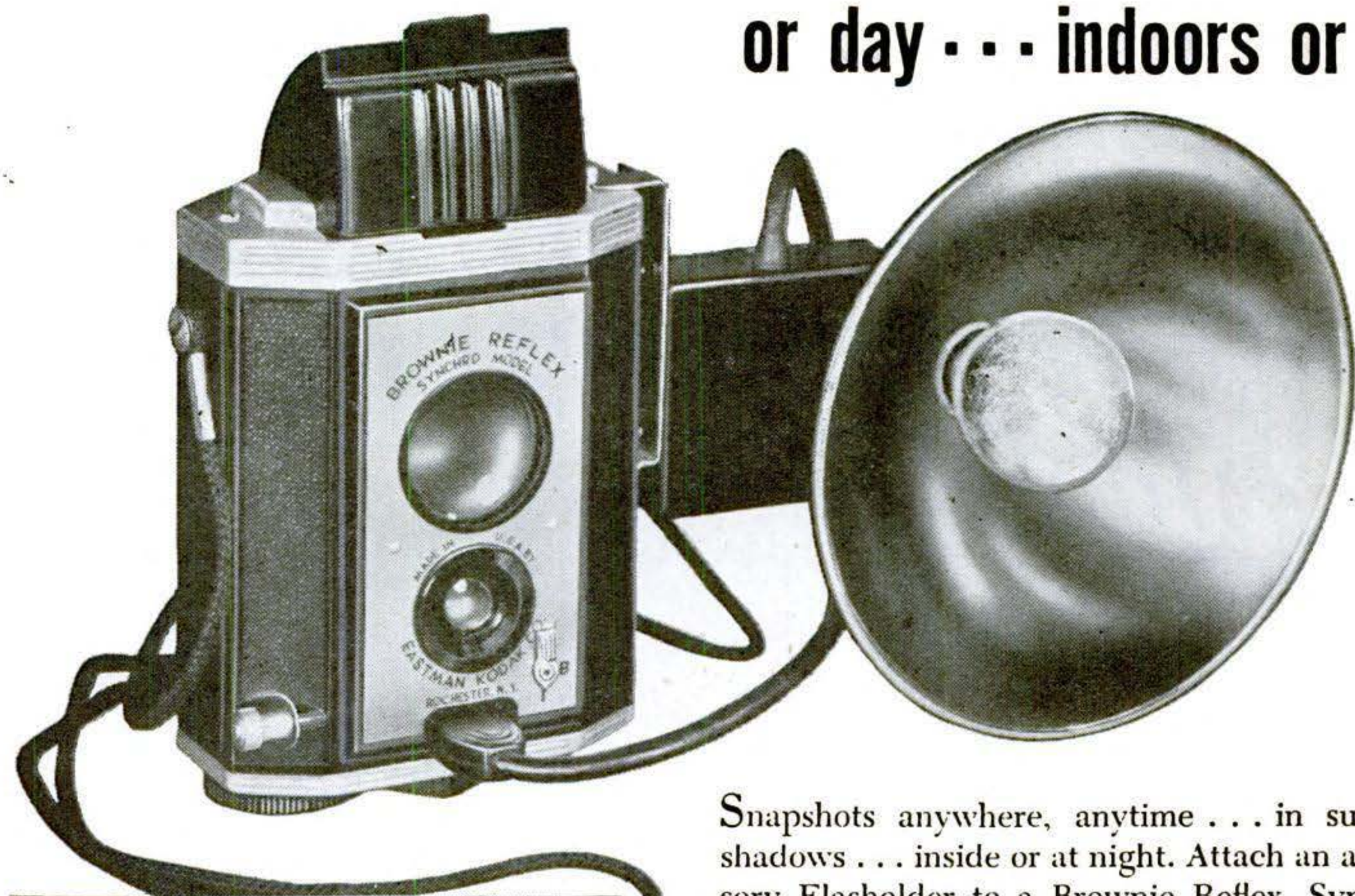
Brownie Reflex—for good snapshots night or day . . . indoors or out



Snapshots anywhere, anytime . . . in sun or shadows . . . inside or at night. Attach an accessory Flasholder to a Brownie Reflex, Synchro Model—insert a bulb—and you're ready to go. One button to push for both shutter and flash. Big brilliant finder previews your picture in actual size before you snap it.

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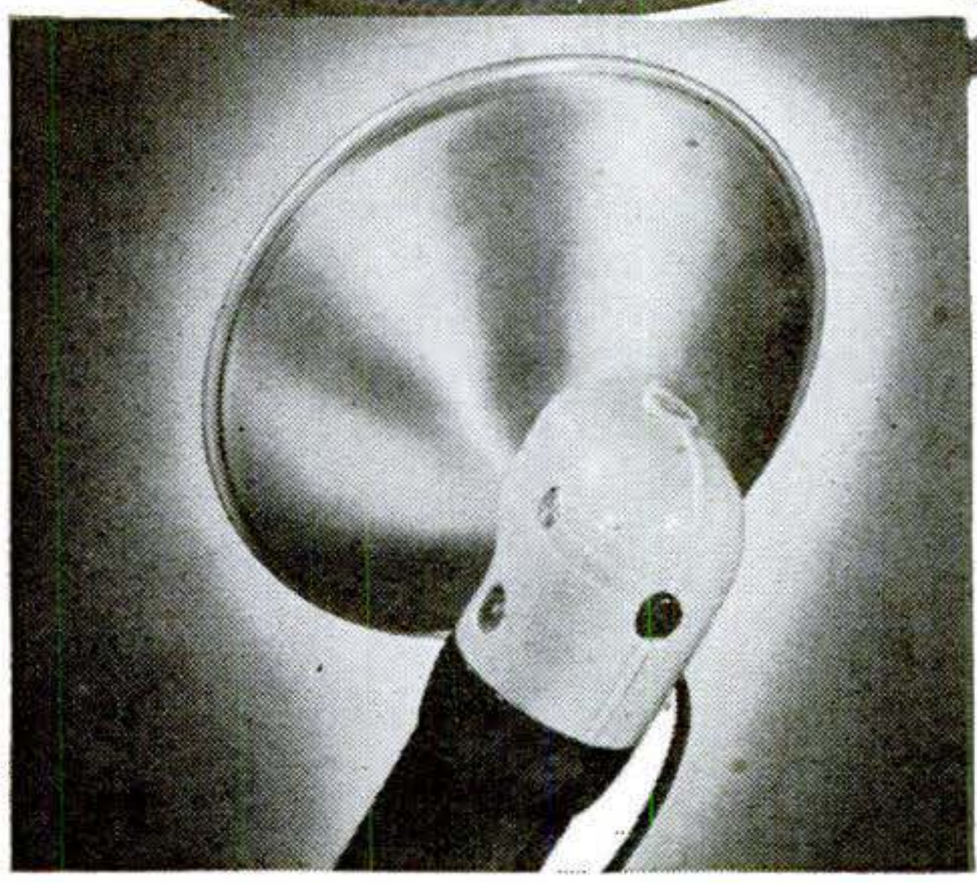

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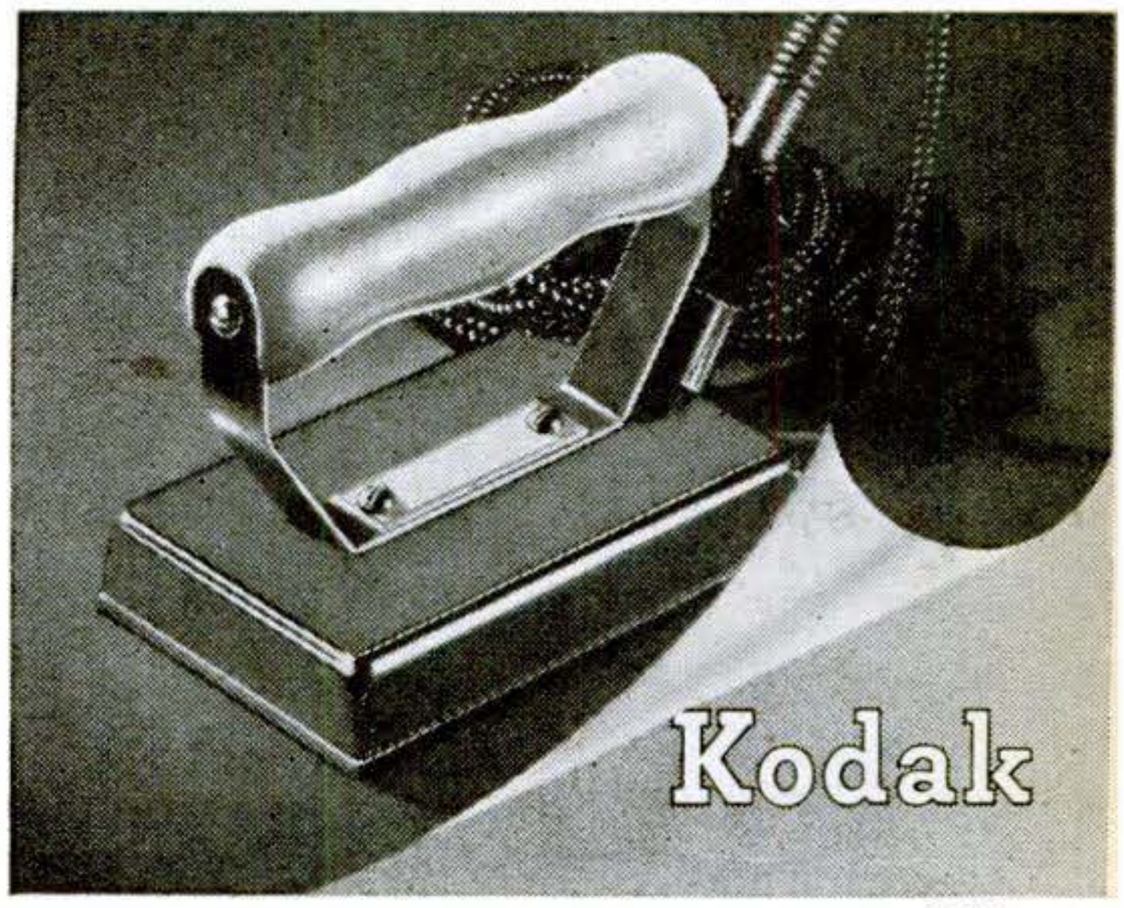
Here's a way to prevent curling and buckling of prints mounted in albums. Use Kodak Thermount Tissue and Kodak Thermount Iron. You fasten the entire back of print to the page—securely, evenly. This method is recommended for Kodachrome and Kodacolor as well as black-and-white prints . . . EASTMAN KODAK COMPANY, ROCHESTER 4, N. Y.



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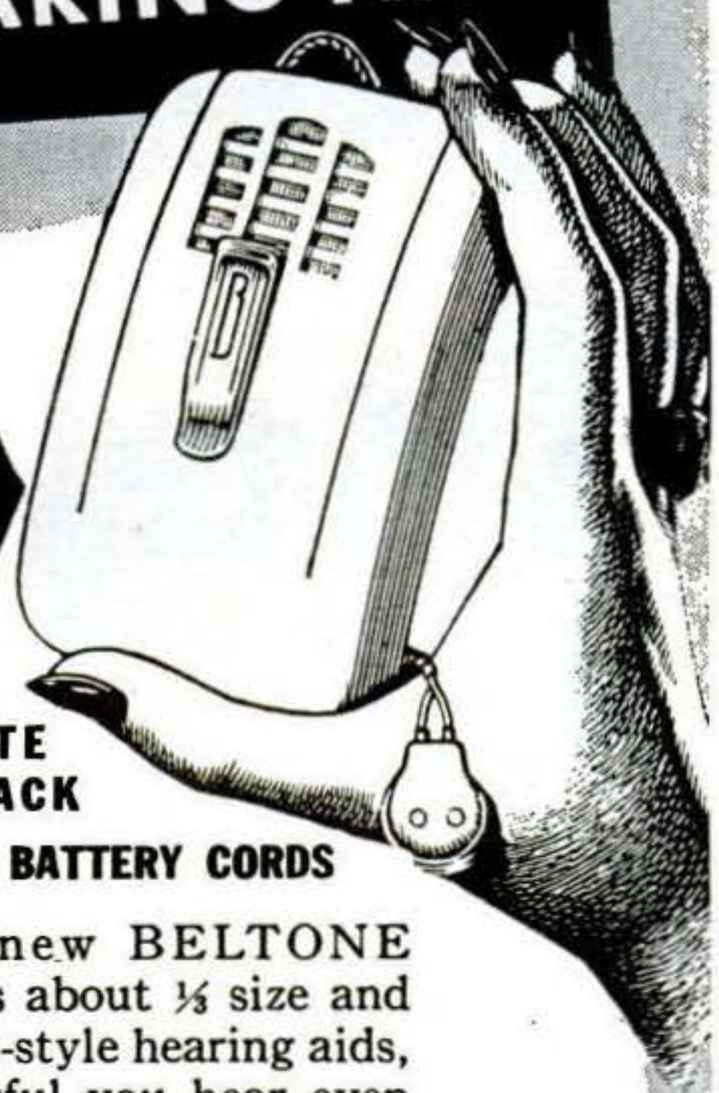

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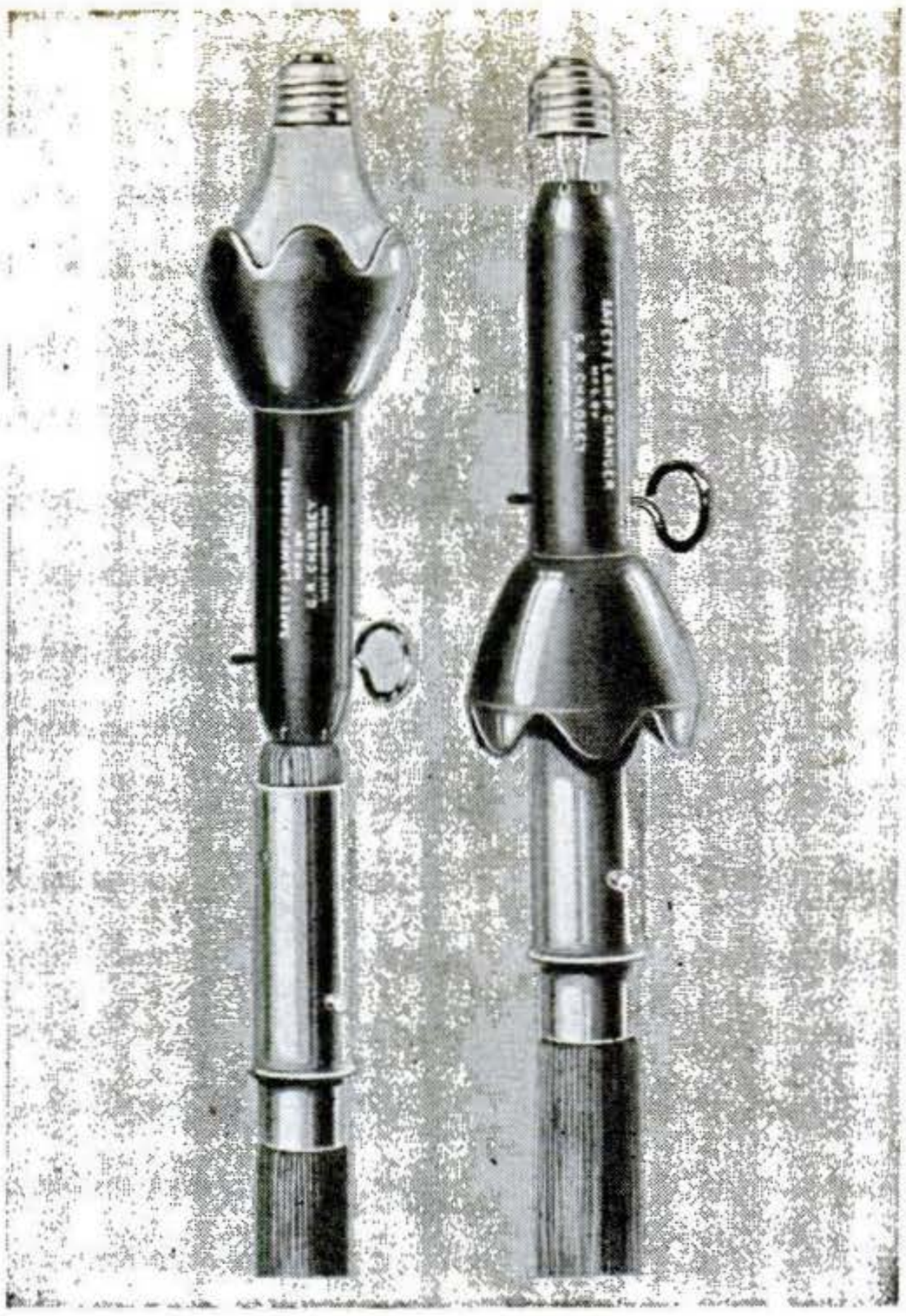

No-Climb Bulb Changer

A RUBBER "hand" on a pole enables you to change a high electric light bulb without climbing, in a new device made by the G. R. Chadsey Mfg. Co., of West Hartford, Conn. Reversed, it removes broken bulbs.

Packaged Hole-Cutter Kit

Two adjustable high-speed steel cutters for making holes from ⅝" to 2½" in diameter are put out in a decorated plastic box by Bruno Tools, of Beverly Hills, Calif. Straight or bit stock shanks are available.

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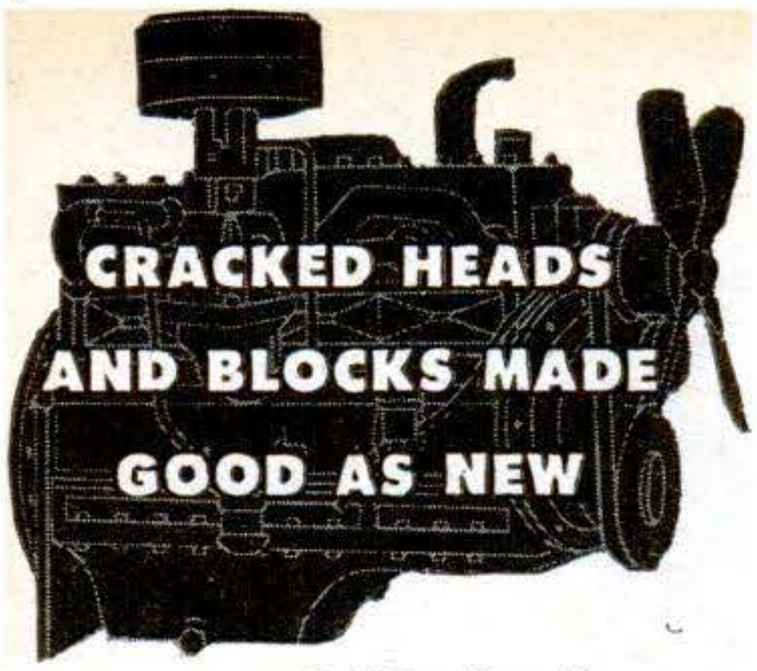
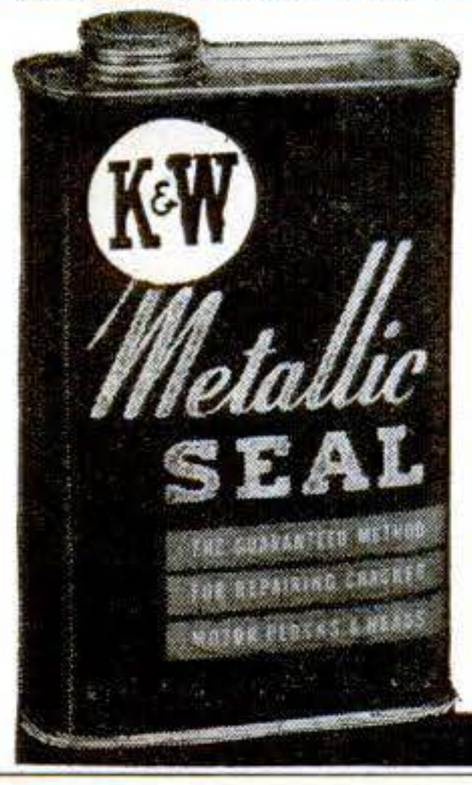


Guaranteed Methods are Safe, Fast, Inexpensive

Junking of cracked engine heads and blocks, costly replacements and long lay-ups are things of the past thanks to K & W repair methods. Used for years by the largest truck and bus operators

K&W METALLIC SEAL MECHANICAL METHOD

repairs are available today at service shops throughout the country. K & W Metallic Seal repairs most heat and freeze cracks in only 30 minutes. Others, extremely serious, are repaired in just a few hours by the K & W Mechanical Method. All K & W repairs are invisible and are guaranteed to last the life of the engine!



Look for the K & W Can! It is your assurance of a *Genuine* GUARANTEED K & W repair. Thousands of service shops everywhere are K & W equipped. Write for names of service shops nearest you.

Kerkling & Company, Burbank, California.

SHEATH "THE NEW MAGIC" -POLARIZED- Rust Control

Again modern science has triumphed over an age-old problem. SHEATH eliminates the causes of rust! In its development, the world's best known rust preventives (lanolin, petroleums, synthetics, solvents new thin wonder oils) were blended...then, given...

The MAGIC OF POLAR ACTIVITY!

Thus was born an unprecedented discovery!—No longer are corrosive elements grease-sealed to metal surfaces to continue their destructive work. SHEATH, through its amazing polarized action, goes through rain water, salt water, sweat, humidity, moisture, direct to the true metal surface and spreads and cleaves in a thin, soft, non-gumming film over the metal...

DISPLACES CAUSES OF RUST

Neutralizes the fingerprints, mildly lubricates as it protects. SHEATH can be applied in any simple manner. It loosens dirt and existing rust, prevents stains. 3-oz. kit bottle, ONLY 50c. Large economy 8-oz. bottle $1.00. At your dealer's or postpaid.

MODEL MAKERS HOME HOBBIESTS SPORTSMEN

Attention: Protect your tools and equipment from the abuse of handling, use and storage. SHEATH withstands indefinite storage anyplace, counteracts elements—keeps new gear new—makes old look better, last longer.

BROWNELL INDUSTRIES, Dept. C-1, Montezuma, Iowa

Heat Generator for Labs

DESIGNED for applying heat to metal and nonmetal objects in experimental laboratories, the new Ther-Monic electric heating generator comes with interchangeable induction or dielectric heating sections. The 1,400-pound generator is made by the Induction Heating Corporation.

Projects Brighter Pictures

BY USING an aspheric condenser system, the new Model AP-3 Viewlex slide projector throws brighter pictures, per watt input, than conventional systems. It is equipped with five-inch Luxtar color-corrected anastigmat f/3:5 lens and a 300-watt lamp. A slide carrier is built in.

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Cars must Start...no matter how cold

You know how difficult it is to start your engine on a bitter cold day. Time and again you've ground your battery away. Even a fully charged battery won't insure a start.

Casite is the *guaranteed* answer to winter starting. No matter how cold, it retards congealing of oil, lets the engine spin over rapidly and start—with less battery drain. Millions of car owners know this from experience.

Casite is sold by service stations, car dealers and garages in every community. For quick starting in winter, put a pint in your crankcase oil now and with every oil change or each 1000 miles. For better and smoother performance year 'round, also put a pint through the air-intake every three months.

NEW MYSTERY THRILLER..."MICHAEL SHAYNE"
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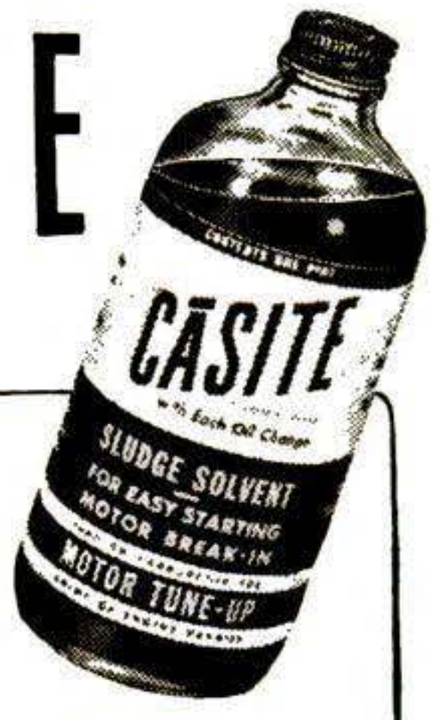

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Quick Starting in Winter Weather or double-your-money-back

GUARANTEE—We guarantee that any motor capable of being started in a warm room will start promptly in the coldest weather when Casite is added to the crankcase according to instructions. If your car fails to start quickly, you get double-your-money-back by filling out guarantee certificate and mailing it to The Casite Corporation, Hastings, Michigan. Maximum refund is $1.30 per pint, twice the nationally advertised price of Casite.

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75c in Canada

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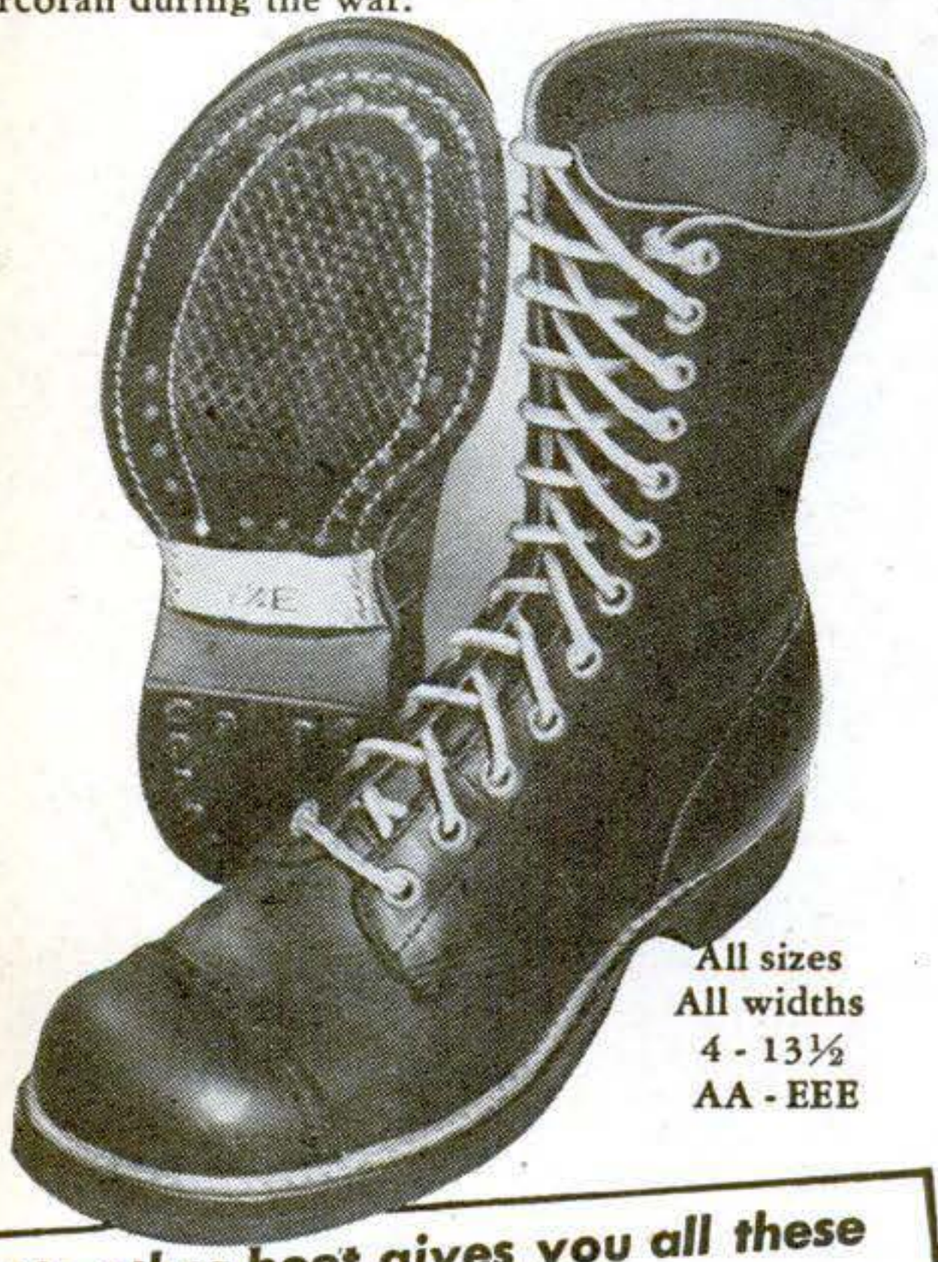
THE ORIGINAL
Paratroop Hunting Boots

The uppers are *waterproof elk* . . . for greater hunting, fishing and general outdoor utility. That's the only difference between these boots and the famous rugged and comfortable Paratrooper Jump Boots, made by Corcoran during the war.



All sizes
All widths
4 - 13½
AA - EEE

No other boot gives you all these EXCEPTIONAL FEATURES

- Made of soft, pliable elk with extra heavy oil waterproofing.
- Full 10 inch height gives proper support.
- Balanced construction gives ideal walking comfort.
- Special heel and toe construction prevents tiring.
- Counter, box toe and bottom filler all leather. Shank is made of steel.
- Heavy reinforcing tape on sides of instep prevents stretching and assures good snug fit.
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- Special Goodyear rubber heel gives maximum springiness and reduces hazard of tripping.

At this Amazing Low Price

These boots are not government surplus stock. We can offer them at this unusual low price only by selling direct to you. Money back if not satisfied on receiving them.

ONLY $9.87 Plus Postage
Postage only is C.O.D

CORCORAN INC., STOUGHTON, MASS.

Please rush a pair of Paratroop Hunting Boots. Check ☐ Money Order ☐ for $9.87 is enclosed. I will pay postage C.O.D.

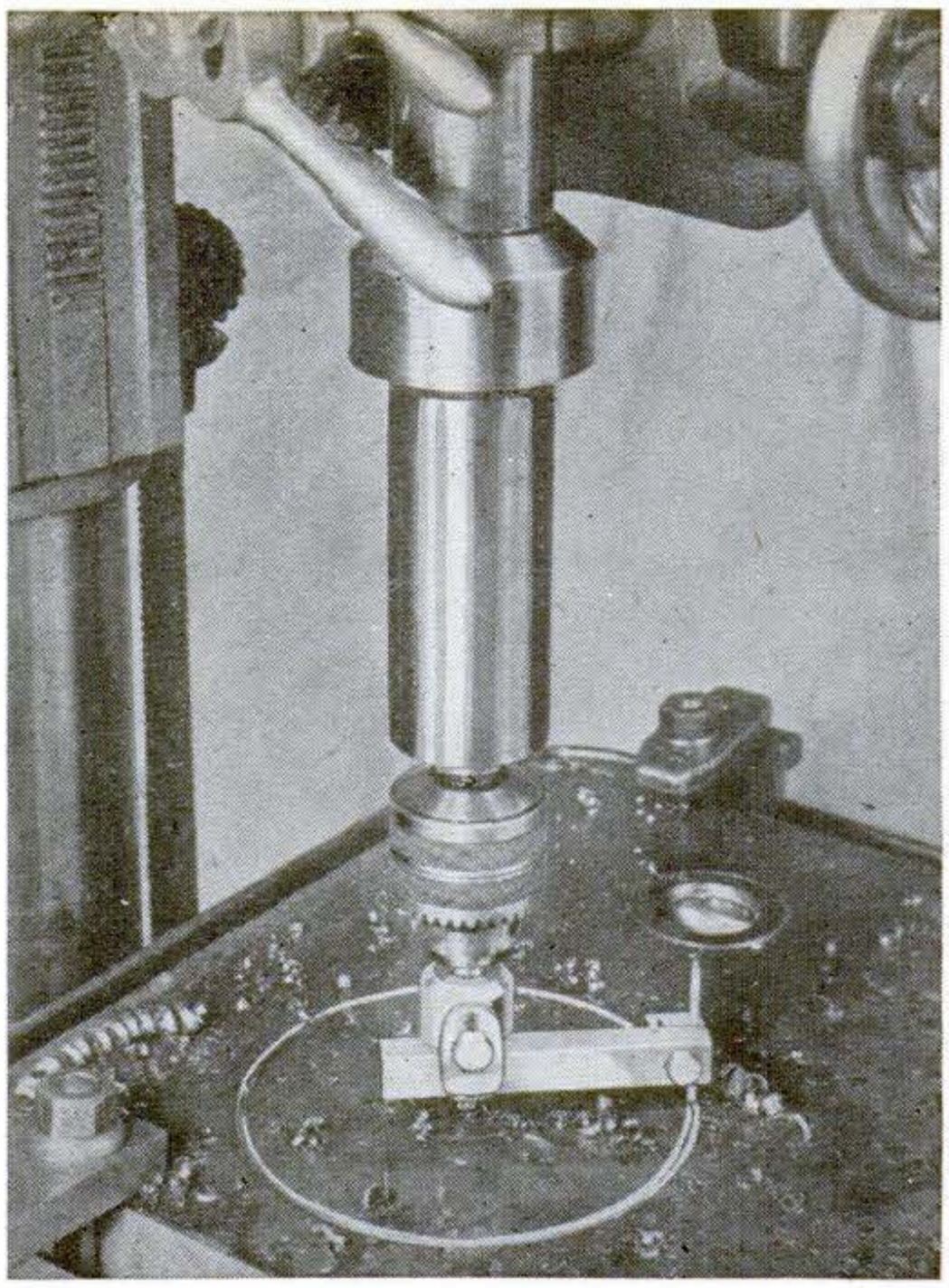
Name _____

Address _____

_____

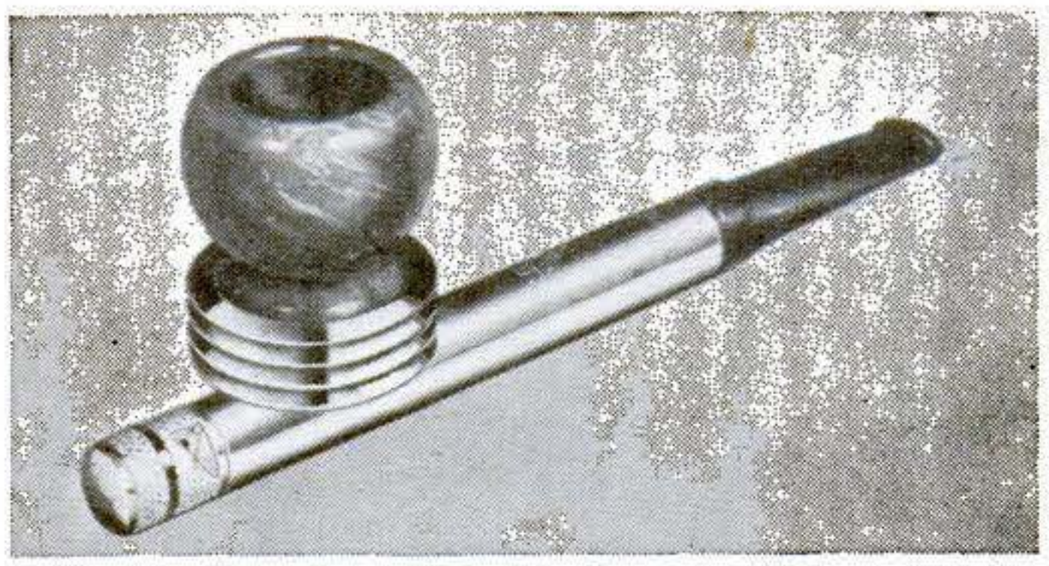
Size and width of Shoe _____

PS-1



Adjustable Circle Cutter

AN ADJUSTABLE circle cutter manufactured by Bruno Tools, of Beverly Hills, Calif., makes holes from 1⅞ to 8 inches in diameter in material up to 1½ inches thick. A combination drill and pilot, with a high-speed cutting blade, is adjustable to depth and thickness. The cutter can be used on wood, steel, brass, hard rubber, aluminum, fiber and plastics.



Pipe Provides Air Control

A GATE-VALVE in the stem of this new pipe, made by the Gentle Mfg. Co., of Detroit, permits regulation of the mixture of smoke and air. It is designed to permit the outside air to remove nicotine, tar and moisture through condensation, while creating a draft up through the bowl that keeps the tobacco alight without constant puffing.

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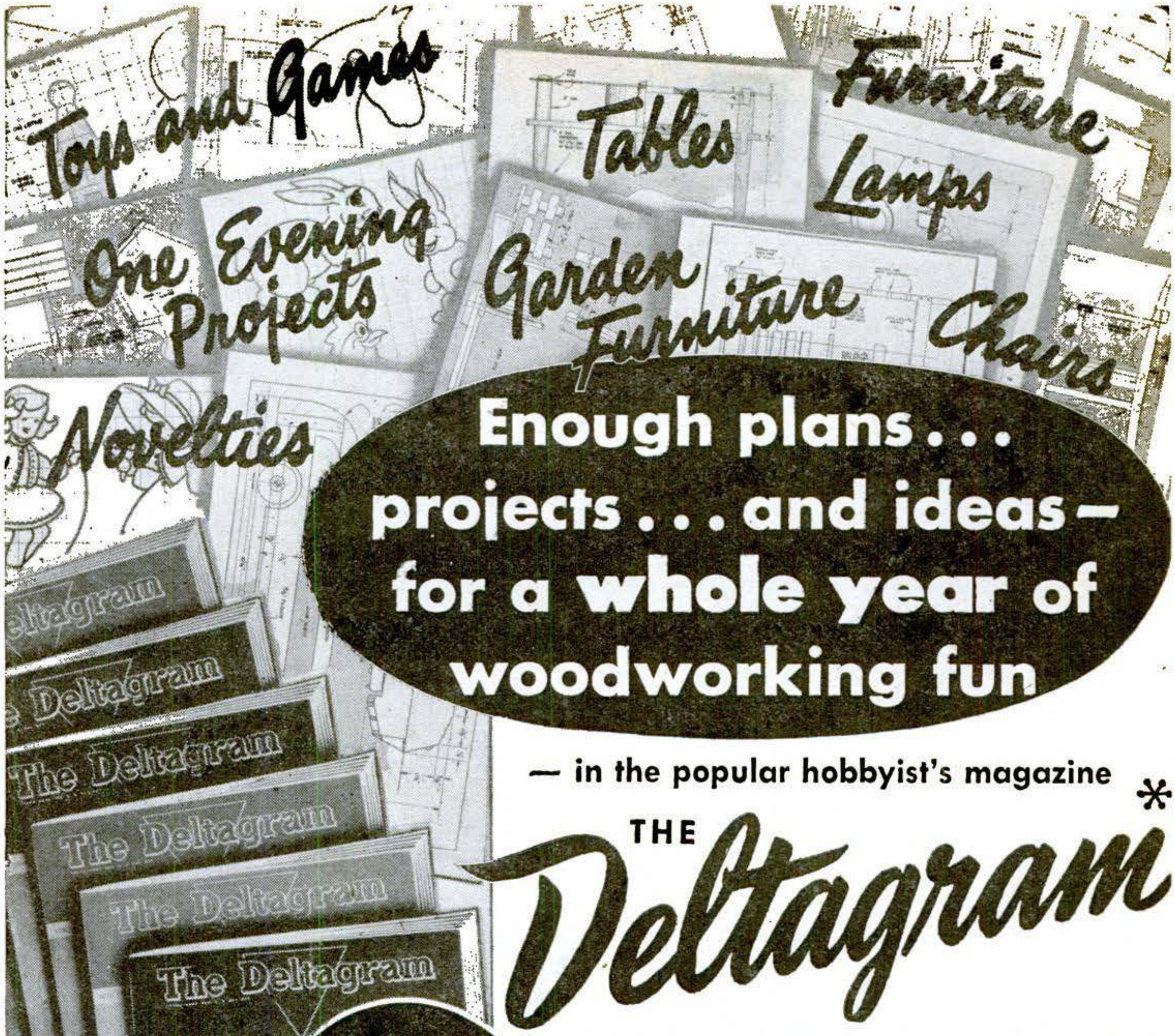

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Just press into place. Use inside or outside. Can be painted. Mortite does not shrink or crack. Also plugs cracks around drainboards, bathtubs, etc.

Roll covers about 80 feet, enough for 5 windows.

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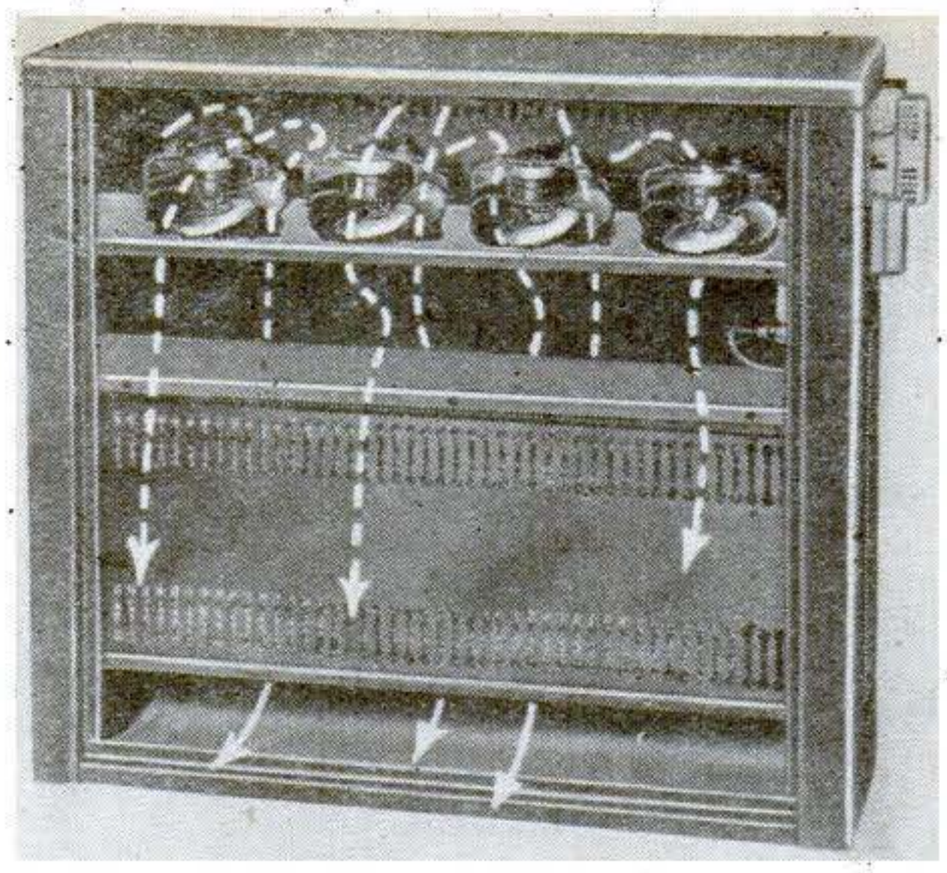

Cools by Drying Air

A NEW air conditioner answers that old saw about it's not being the heat but the humidity that gets you down. Developed by the American Coils Co., of Newark, N. J., the device takes the water out of air, allowing your skin to cool naturally by evaporation. A low vapor-pressure area is created within a cold coil, attracting moisture-laden air from outside.

A MILLION *Happy Moments* **WITH A BURGESS vibro-tool**

The Vibro-Tool, 22 accessories and sharpening stone, in handsome hinged polished wooden box, complete for only $16.50

Have loads of fun... spend leisure time profitably making unusual gifts with this unusual tool. Cuts out linoleum blocks (illustrated), tools leather, engraves metals, plastics, jewelry. Does craft and shop work electrically, easier, faster! 110 V. 60 cycle A. C.

Tool with engraving needle, $7.50

See your dealer or order direct

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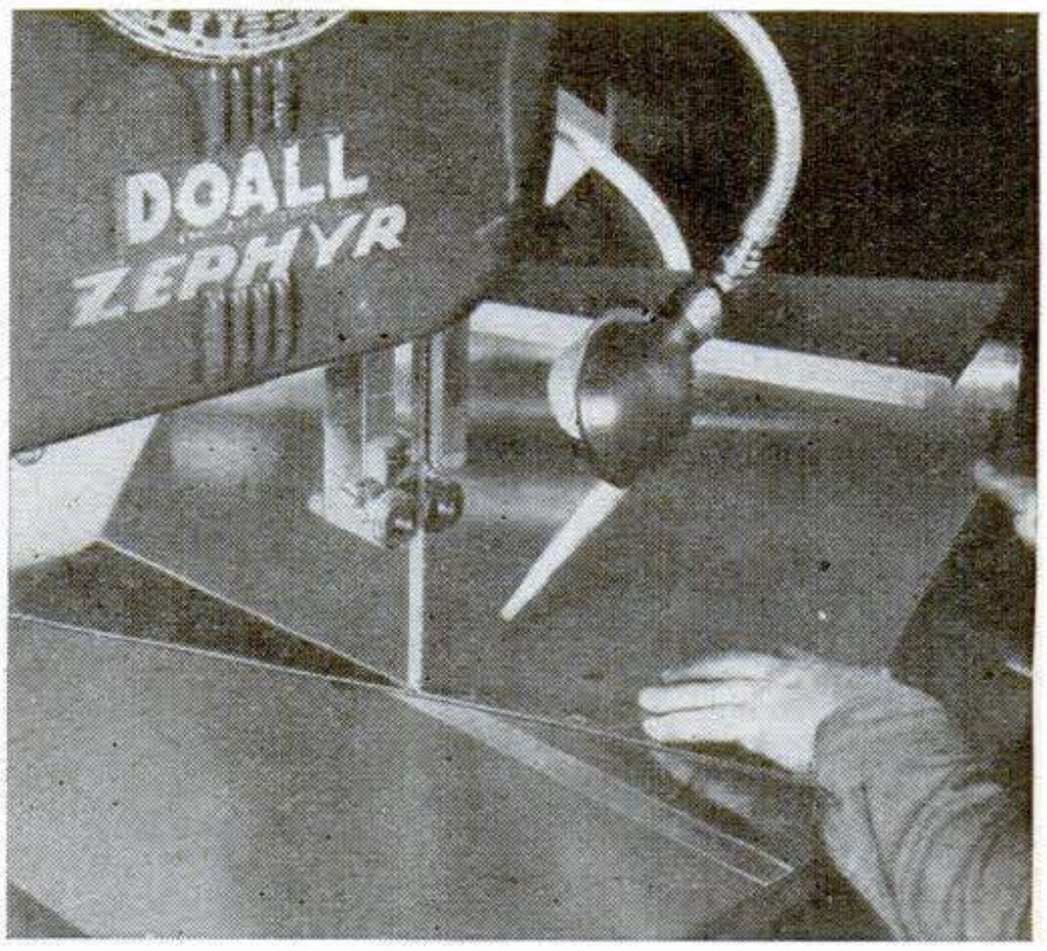

Cuts Metal, Wood or Plastic

THE Zephyr 16, developed by the DoAll Co., of Minneapolis, rips through metal, wood or plastic. Featuring a 16-inch throat and 10-inch thickness capacity, the saw cuts 48.6 inches of ⅛-inch stainless steel per minute. Saw speeds range from 1,000 to 5,000 feet per minute.

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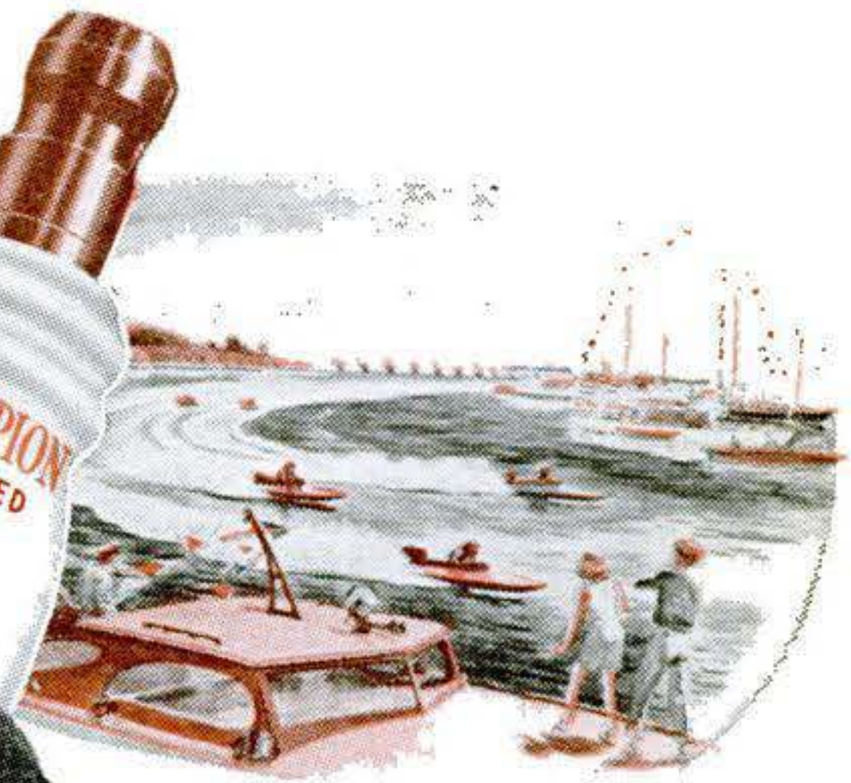
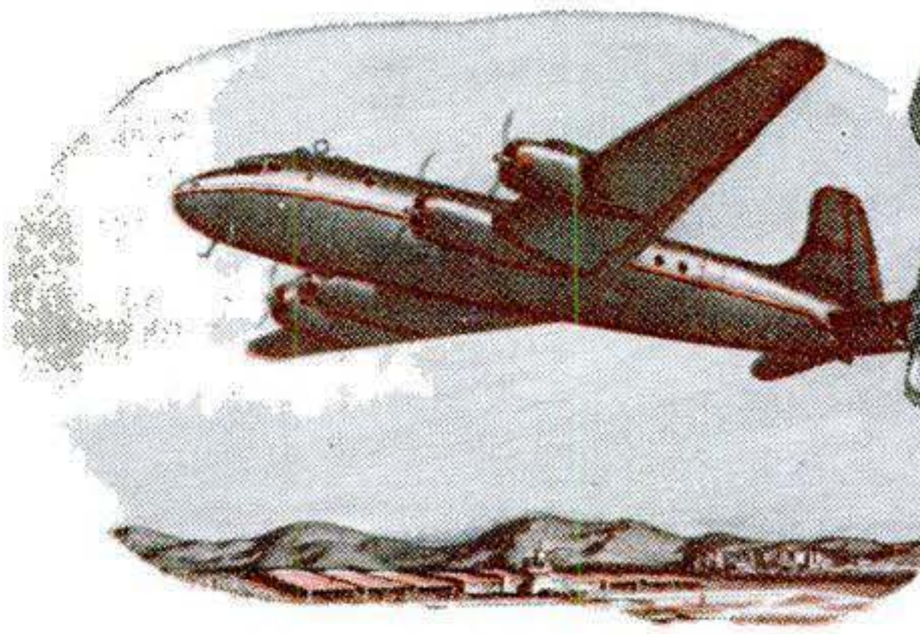
IN EVERY FIELD

AMERICA'S FAVORITE SPARK PLUG!

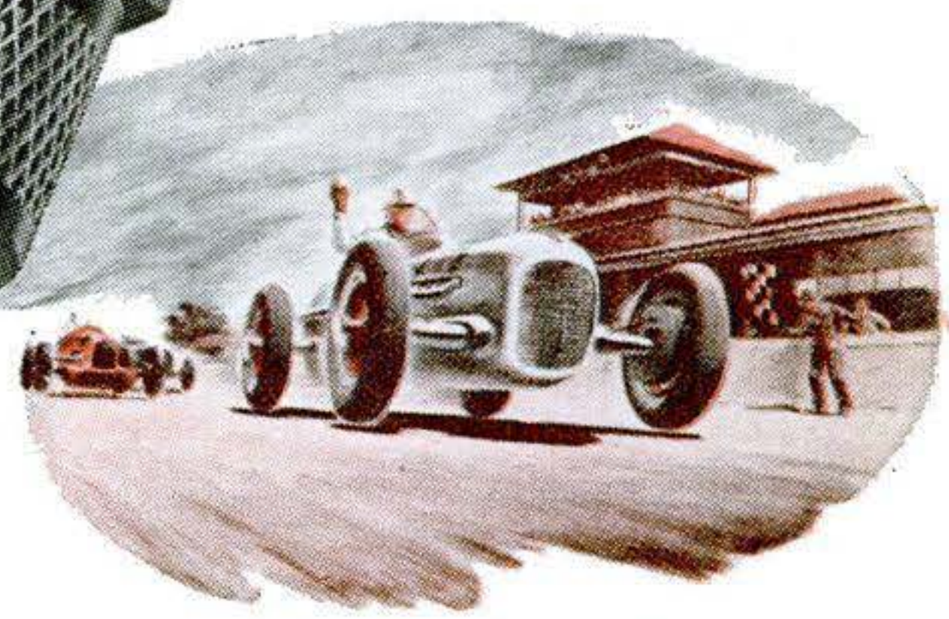
BUS AND TRUCK



MARINE



AVIATION



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AUTOMOTIVE

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FOLLOW THE EXPERTS DEMAND DEPENDABLE

CHAMPIONS

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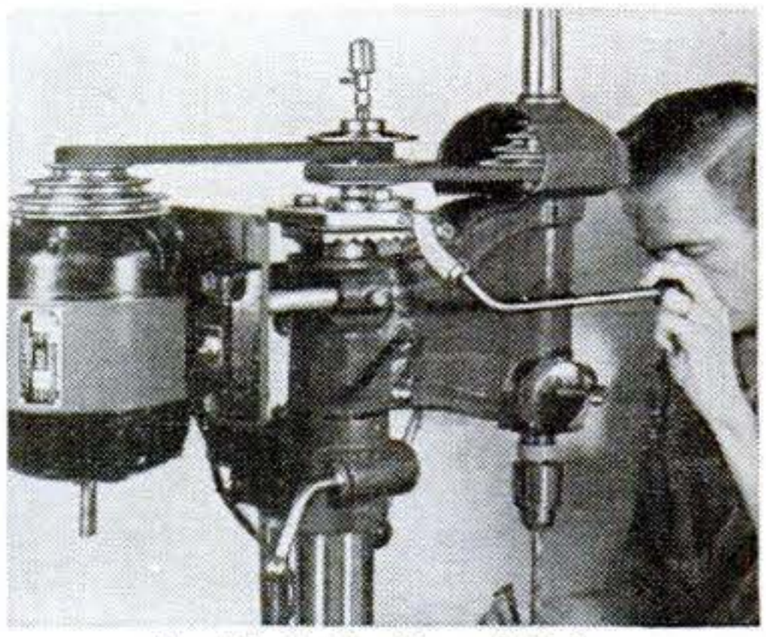
Ingenious New Technical Methods

To Help You Simplify Production

Variable Speed Drive Attachment Offers Instant Speed Control for Drill Press Work!

Now you can adjust drill press speeds from high to low—or any intermediate speed—as easily as shifting gears in your car! The Era Variable Speed Drive Attachment enables the operator to provide the correct speed for large or small drills by merely moving a lever. This saving in time results in greater work volume, better work, and lower production cost.



Era Variable Speed Drive

The Era Attachment fits all popular makes of drill presses, and is easily installed without the necessity of drilling holes or changing present equipment.

To also help save time on the job, many plant owners make chewing gum available to workers. Chewing gum seems to make work go easier, time go faster. Wrigley's Spearmint Gum may be used even when both hands are busy, eliminating work interruptions, and thus promoting greater safety for the operator.

You can get complete information from Era Meter Co.
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Television camera, receiving tube, all-electronic receiver and radio relay equipment—are the result of pioneering and research at RCA Laboratories.

Behind every big stride in Television—RCA Laboratories!

From the scene of action—to your own living room—these RCA developments based upon research at RCA Laboratories mean *television at its finest:*

RCA Image Orthicon Camera sees whatever the eye sees, even in the light of a match! Sports events on cloudy days or in twilight do not fade because this camera eliminates the need for strong lighting.

RCA Mirror-backed Kinescope—All the lifelike realism and detail caught by the super-sensitive RCA Image Orthicon Camera is reproduced by this new receiving tube.

RCA Victor Television Receiver—with the new RCA exclusive "Eye Witness" feature that "locks" the picture in tune with the sending station.

RCA Radio Relay equipment enables television stations to broadcast events taking place at a considerable distance from the studio, and eventually may link television stations in networks.

In television, as in radio, records or tubes, if it bears the name RCA or RCA Victor it is one of the finest instruments of its kind science has achieved.

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to the RCA Victor Show, Sundays, 2 P.M., Eastern Time, over NBC.

RCA Victor table model television receiver with the exclusive "Eye Witness Picture Synchronizer" that assures you *brighter, clearer, steadier pictures.*

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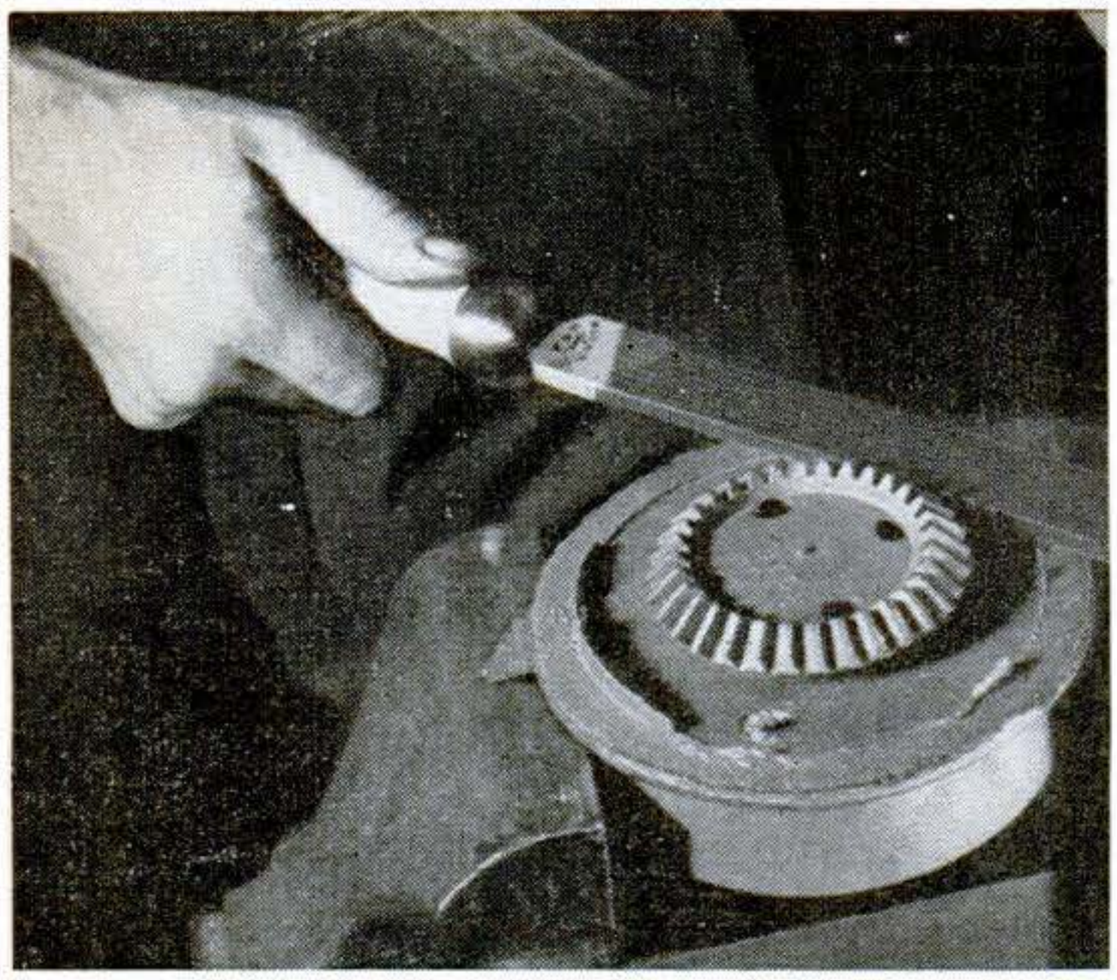

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SNAGGING a rough casting with an ordinary file is a sure invitation to headaches — *and "toothaches."* Hard projections and sharp edges put a severe strain on regular file teeth —often cause them to shell or break out under pressure. Roughing-down calls for a file with an exceptionally strong tooth construction.

The right file for the job is the Nicholson or Black Diamond Special-Purpose Foundry File, with extra-sturdy teeth designed to absorb shock and resist breaking. Specializing in rough use—like knocking fins and sprues off foundry castings or filing the narrow edges and sharp corners of dies—this "bruiser" of the file family continues to give efficient service long after regular files are discarded.

• **OTHER NICHOLSON AND BLACK DIAMOND SPECIAL-PURPOSE FILES** of interest to mechanics and home craftsmen include files for: Aluminum, Stainless Steel, Brass, Lead, Die Castings, Die Making, Lathe Filing, plus milled Curved Tooth files and a wide range of Swiss Pattern precision files. Obtainable through industrial distributors and good hardware dealers.

FREE BOOK, *"FILE FILOSOPHY,"* *on kinds, uses and care of files.*

NICHOLSON U.S.A.

NICHOLSON FILE CO.
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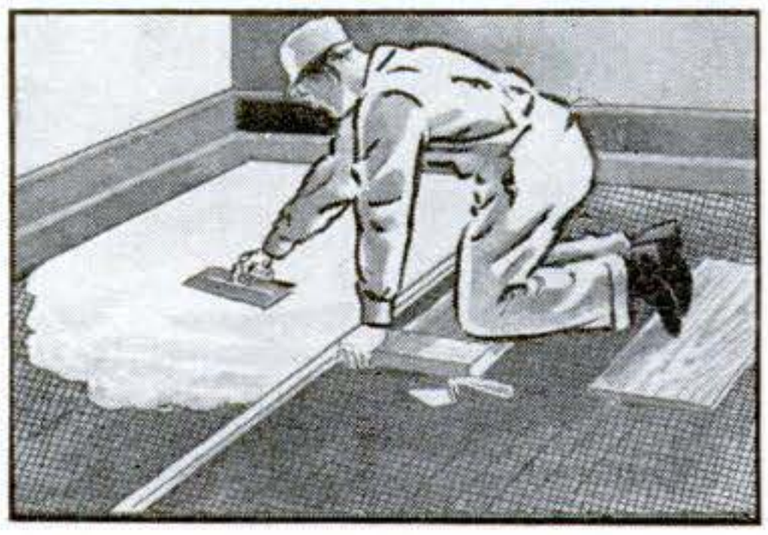
EASY TO APPLY



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What? Horsepower in a Flashlight Cell?

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FLASHLIGHT USERS! Look what science has done to give you better light: Great new "Eveready" flashlight batteries *now* produce 93% more energy! Nearly *double* the power output of even pre-war "Eveready" cells, long the world's standard for brilliant light, long life, and uniformity. Now you get dazzling bright light for almost twice as long! Ask for new "Eveready" flashlight batteries – they've got *POWER!*

The registered trade-mark "Eveready" distinguishes products of

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Unit of Union Carbide UCC *and Carbon Corporation*

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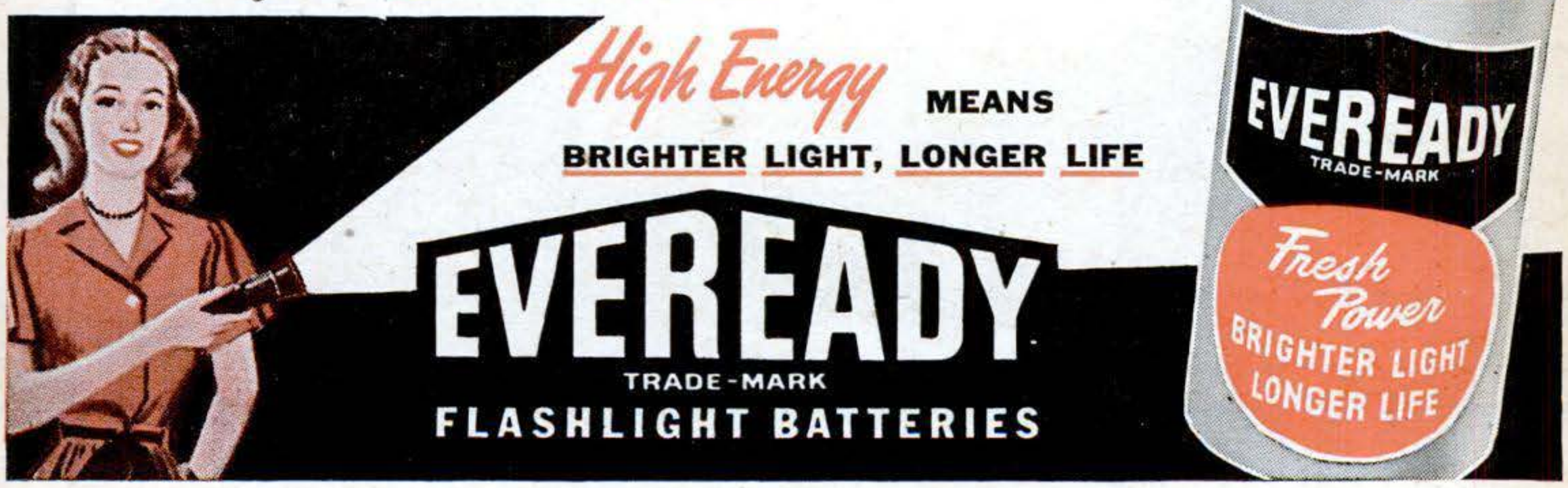
93% MORE ENERGY



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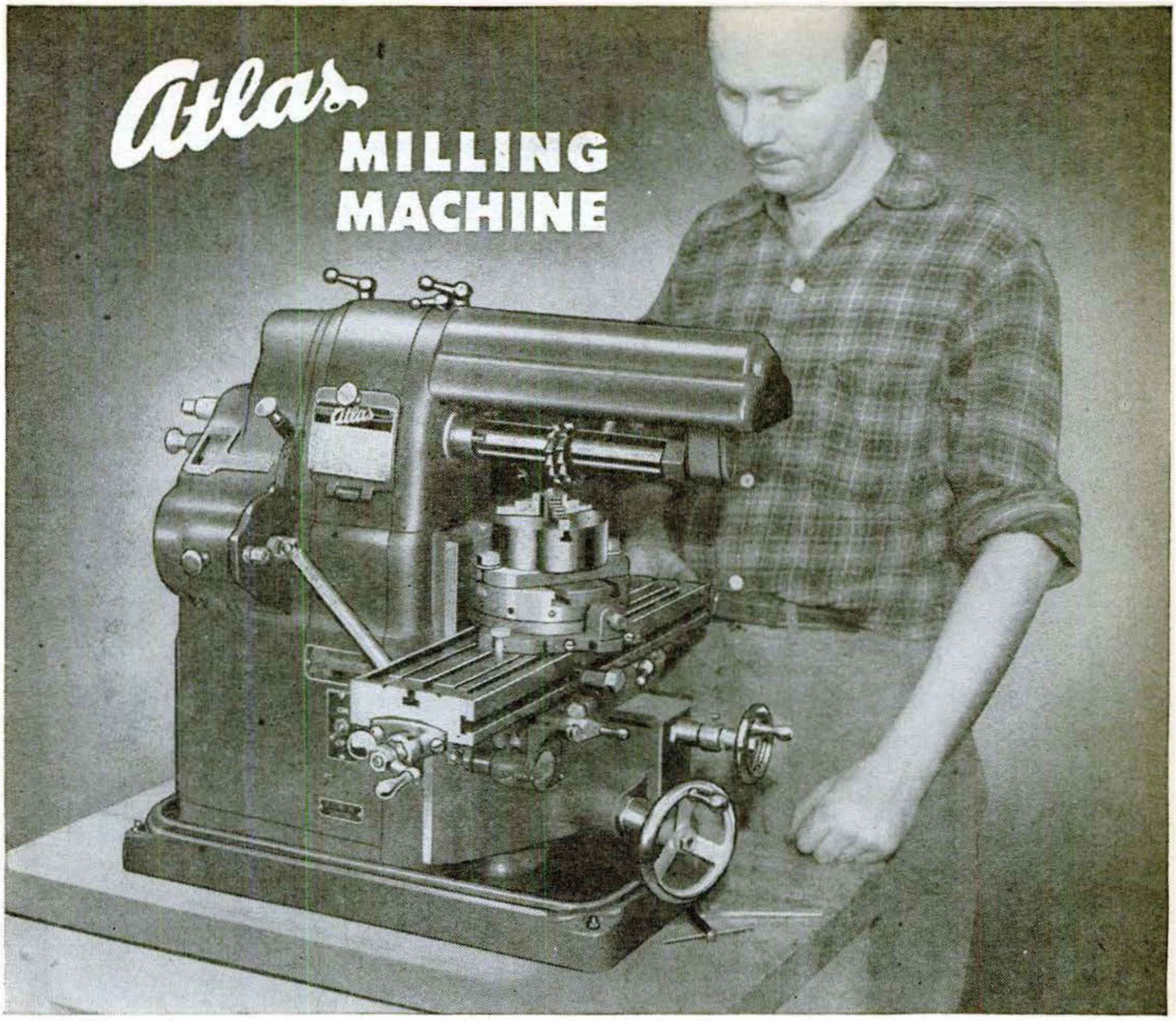

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MOST PRACTICAL of all winter hobbies is a well-equipped home work shop.

It's a quick, sure way for business and professional men to get away from daily cares, relaxing to the restful hum of busy tools. Most valuable, too, in repairing home equipment and making useful articles for home or business.

For inventive men — with commercial ventures in mind — an Atlas-equipped shop helps you make working models of your ideas, and go into production on them when they prove practical.

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"Dead-Locker"

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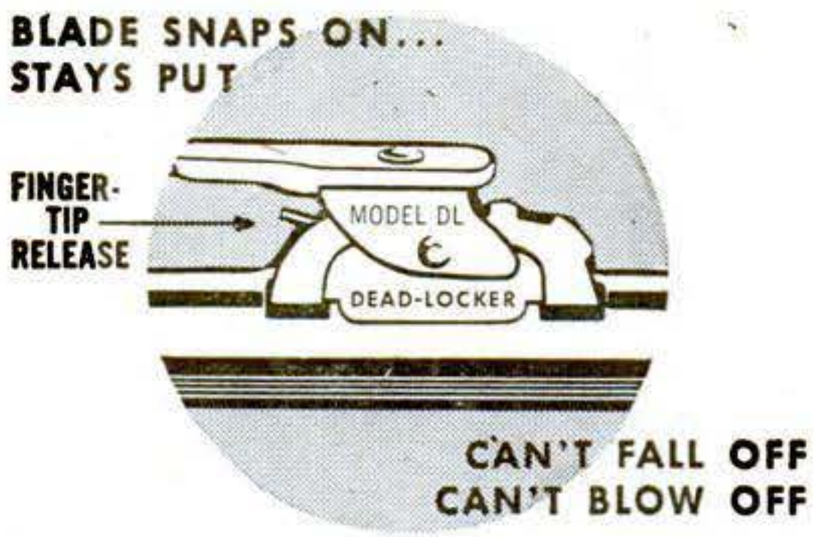

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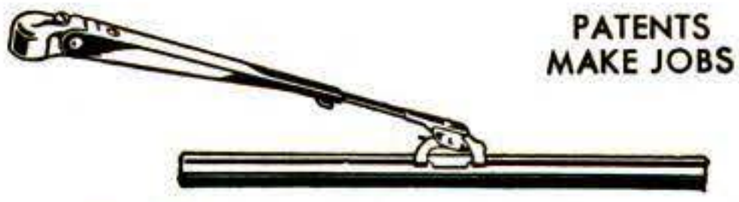
He's doing the best he can. Sure, he knows how dangerous it is for you to drive your car . . . in stormy weather . . . with your dull old windshield wipers that smear and smear. He'd gladly put on for you quickly a pair of keen new ANCO RAIN-MASTER Wiper Blades and Arms. He has them—Newest Models! But he forgets to remind you? Too busy? You can't shoot him for that!



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Ask for RAIN-MASTER Windshield Wiper Arms and Blades next time you buy gas.

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Finest Achromatic Lenses.
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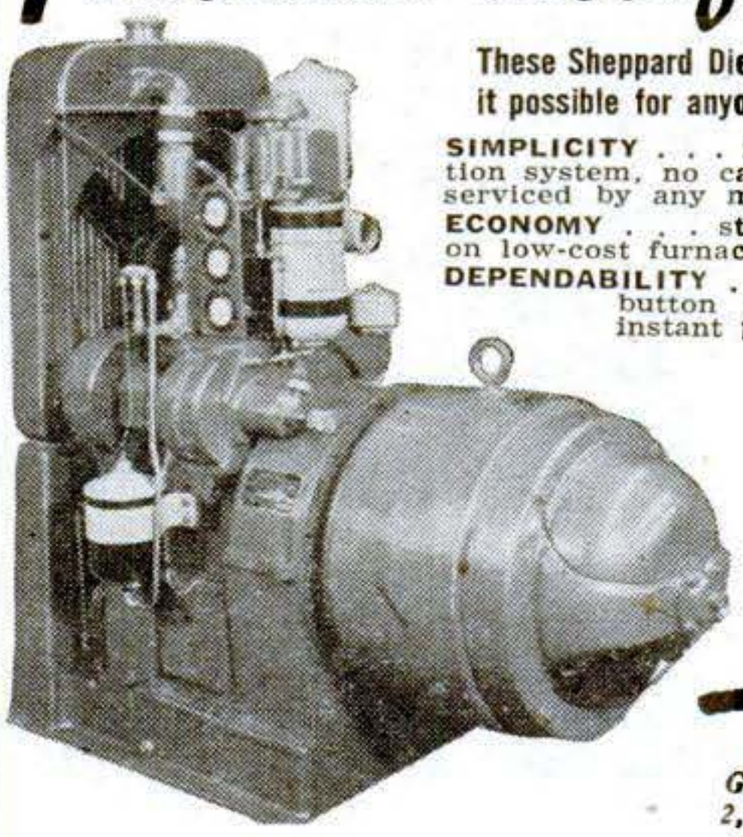
Power . . . *independent of outside interference*



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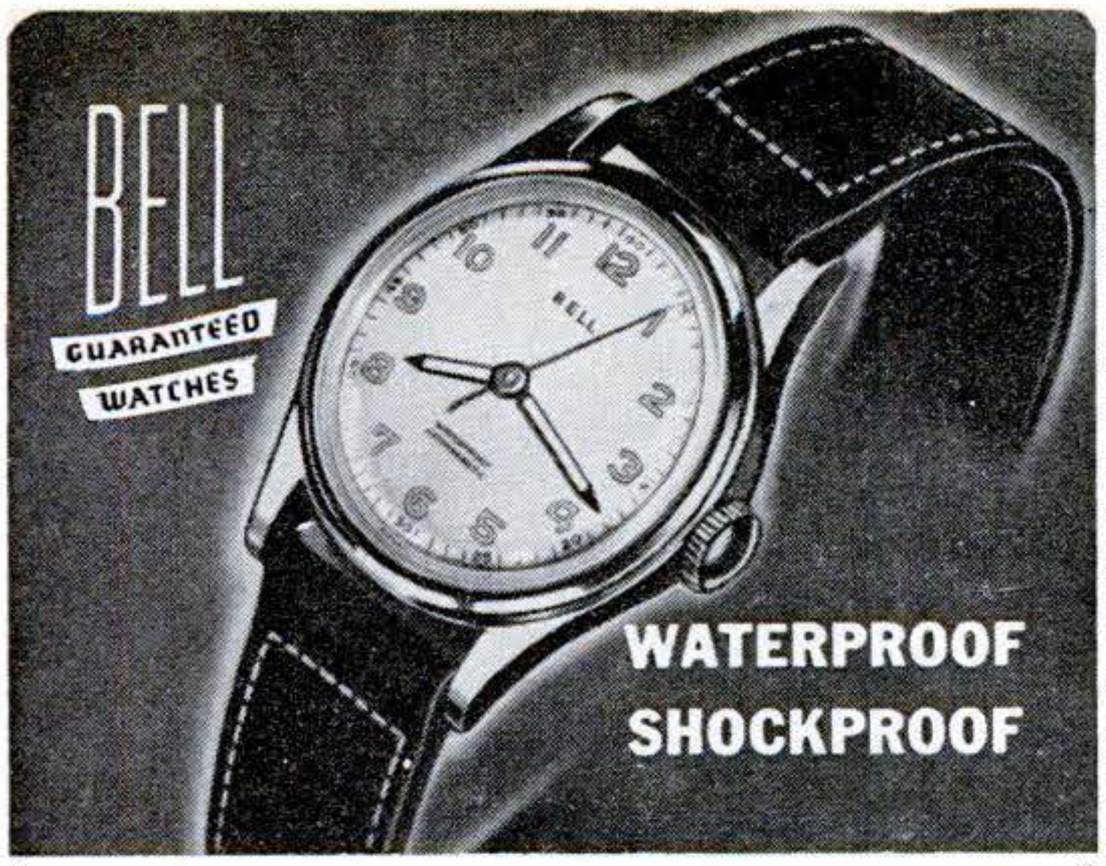

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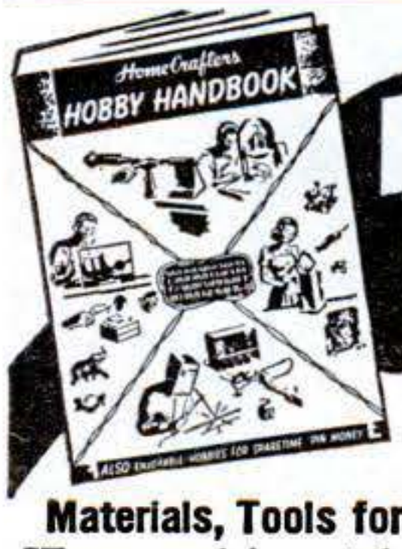

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IF you work in metals, woods, plastics or glass, you need this Big, FREE Source Book of equipment, tools, parts and materials . . . including dozens of hard-to-get items you can't find in stores. Many things you must have for your home hobby or shop. Just loaded with ideas and illustrations.

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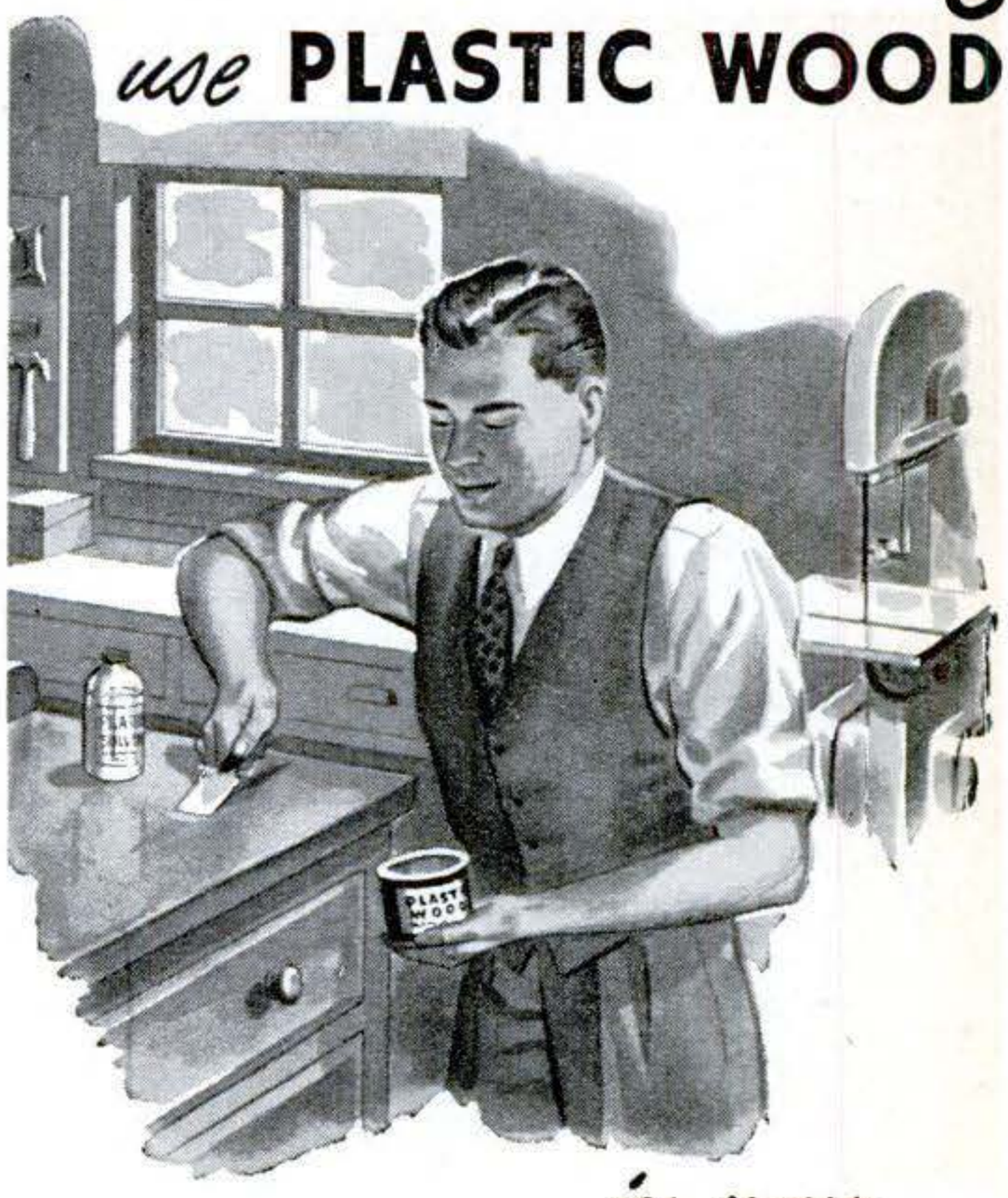

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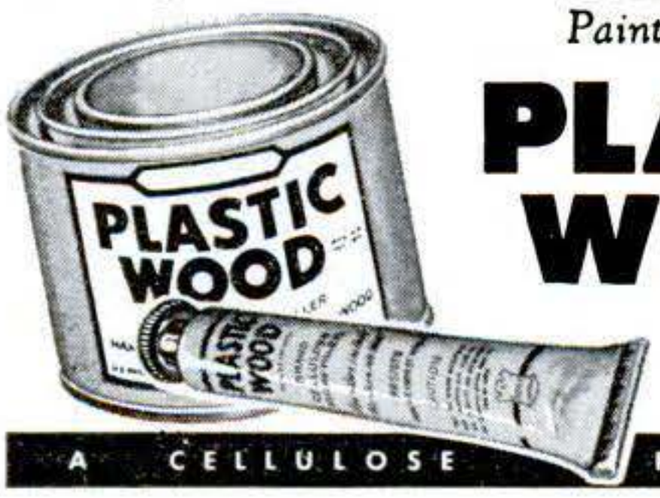

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My Pressure-Stats should be set for:
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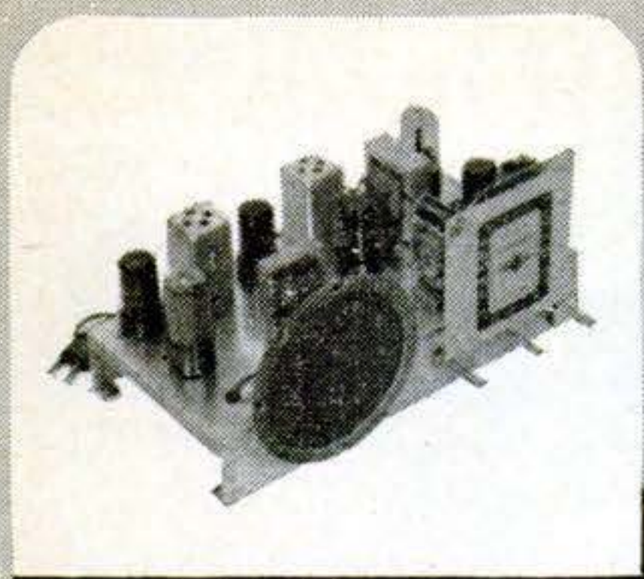

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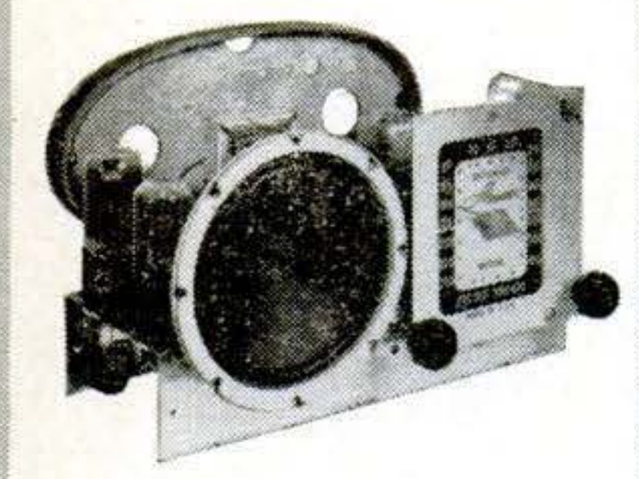
It's Easy WITH THESE NEW KITS

NEW BARGAINS AT NEWARK



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Cabinet ..... $5.95 extra

Both sets are complete, easy to build, fine performers. These as well as many other bargains are available now at Newark. Write for our Super Bargain Bulletins. Visit our stores, talk "shop" with our personnel, and see some great radio and electronic equipment.

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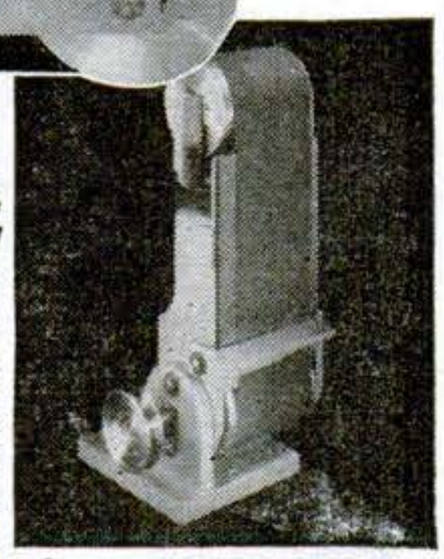
AND TOOL GRINDER

WOODS MODEL 40—For home work shop woodworking and machine shop production



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Husky sander for metal, plastics, wood, glass and rubber; perfectly-balanced completely machined pulleys (4" dia.) . . . ball-bearing thruout . . . drive shaft supported on both ends. These features assure maximum efficiency, smooth operation and long life. Tested to 5000 rpm. . . . easy adjustment for horizontal or vertical operation . . . reversible platen usable on either face.

Extra belts, 5" x 6" work table, and other accessories available from stock.

Order from your dealer or shipped FOB direct from our S. Norwalk Plant

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Bench Space	9" X 15"
Motor Recommended	1/3 hp.
Net Weight	17½ lb.
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SANDER COMPLETE WITH BELT AND WORK DAM $39.95

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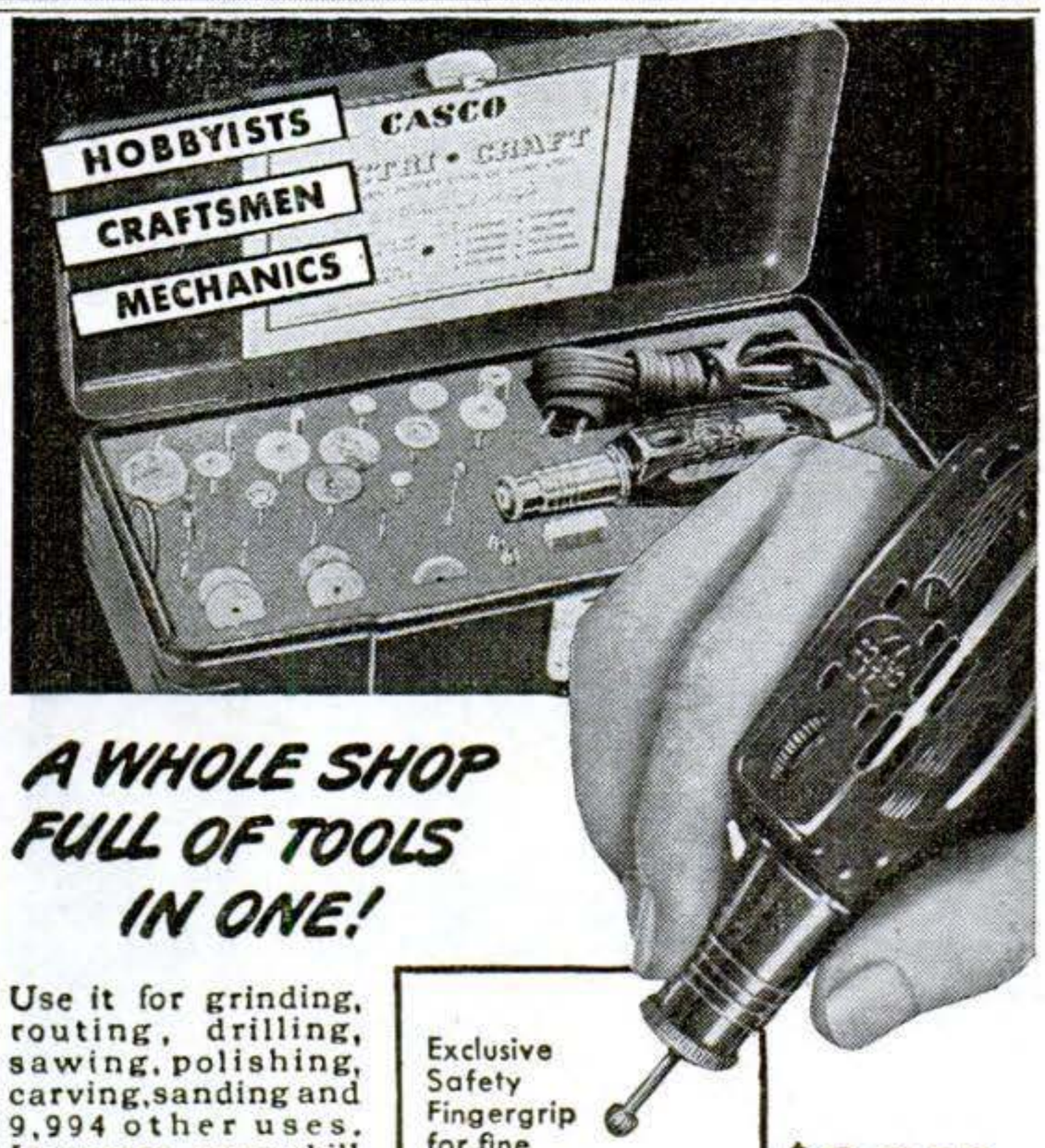

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Use it for grinding, routing, drilling, sawing, polishing, carving, sanding and 9,994 other uses. Increases your skill and your scope. Precision-engineered, AC-DC. More exclusive features than any other tool.

Exclusive Safety Fingergrip for fine detail work

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COMPLETE WITH 36 ACCESSORIES IN FITTED STEEL CASE
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Works Wood, Metal, Glass, Plastics

CASCO ELECTRI-CRAFT TOOL KIT
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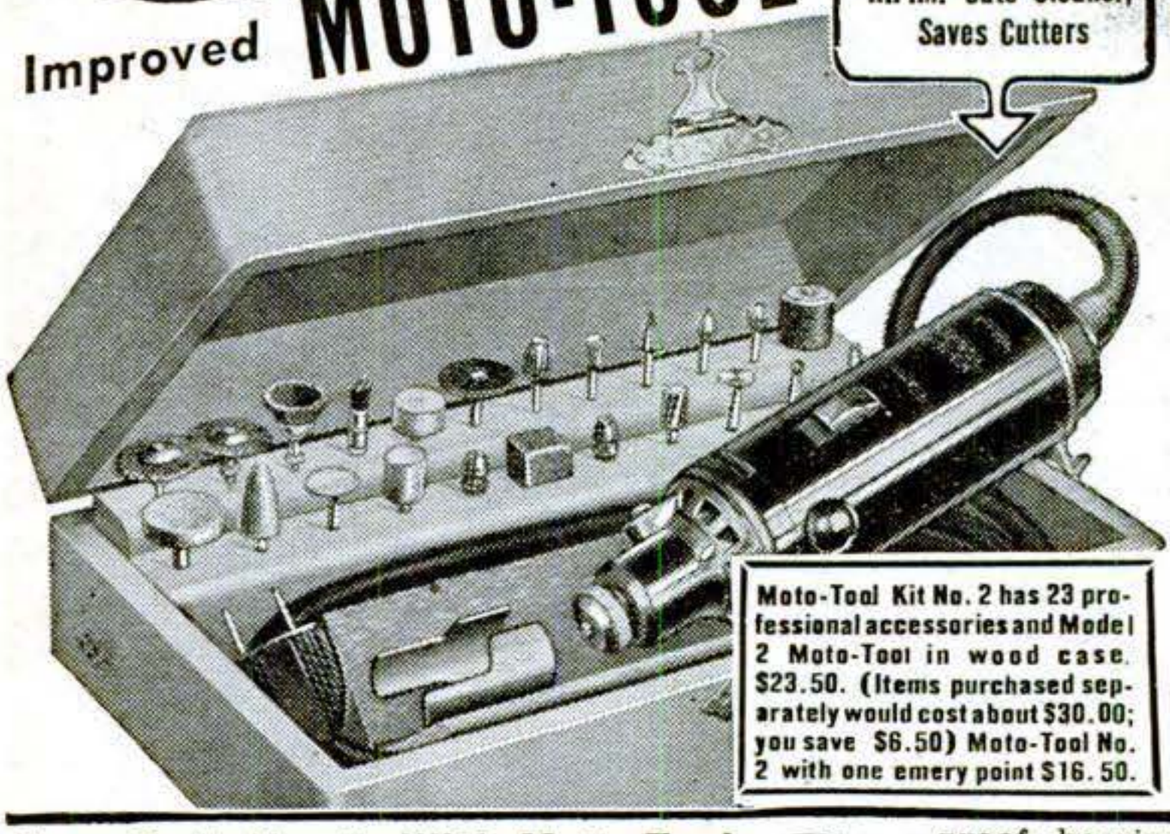

Moto-Tool Kit No. 2 has 23 professional accessories and Model 2 Moto-Tool in wood case. $23.50. (Items purchased separately would cost about $30.00; you save $6.50) Moto-Tool No. 2 with one emery point $16.50.

"MAN . . . WHAT A POWERHOUSE!"

A TOOL THAT PACKS YEARS OF PLEASURE

Here's a tool to please a man's heart. A gleaming "powerhouse" that holds promise of endless creative hours. This "pocket-size machine shop" is a war veteran . . . used by all branches of the armed forces in far flung repair bases . . . and it helped set production records at General Electric, Westinghouse, Remington Arms, Ford and other plants. Hobby enthusiast or expert craftsman . . . first choice is model 2 Moto-Tool kit, with its handsome, felt-lined, highly finished wood case . . . with rows of tools begging to be put to work. The usefulness of Moto-Tool for precision work is increased by two versatile attachments now available at slight additional cost (see below).

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Housing has "pencil-type" finger grip. Instant-action, wrenchless chuck. Oil-less, sealed, trouble-proof bearings. Patented automatic chuck lock pin. Oversize armature shaft, hardened, ground and polished. 110 volt, universal type motor. Easily replaced commutator brushes. Sliding snap type switch. Handy hanger hook. Cord protector. Sturdy, shockproof bakelite housing. Dust-filtered, air-cooling system. Weighs only 13 oz. . . . shaped to fit the hand. Dynamically balanced for vibrationless operation.

Free Both Hands With Moto-Tool Attachments

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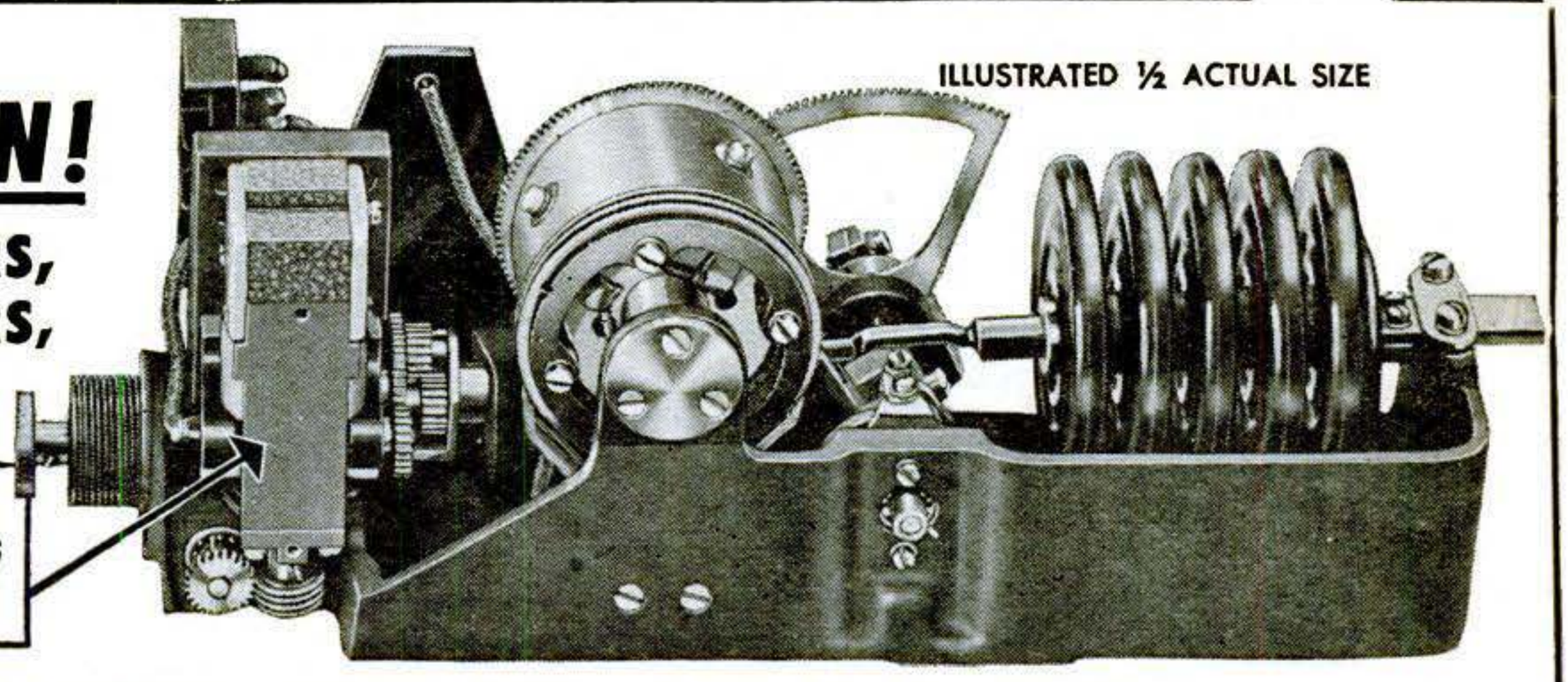
MODEL MAKERS, EXPERIMENTERS, INVENTORS

ILLUSTRATED ½ ACTUAL SIZE



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Featuring this Powerful

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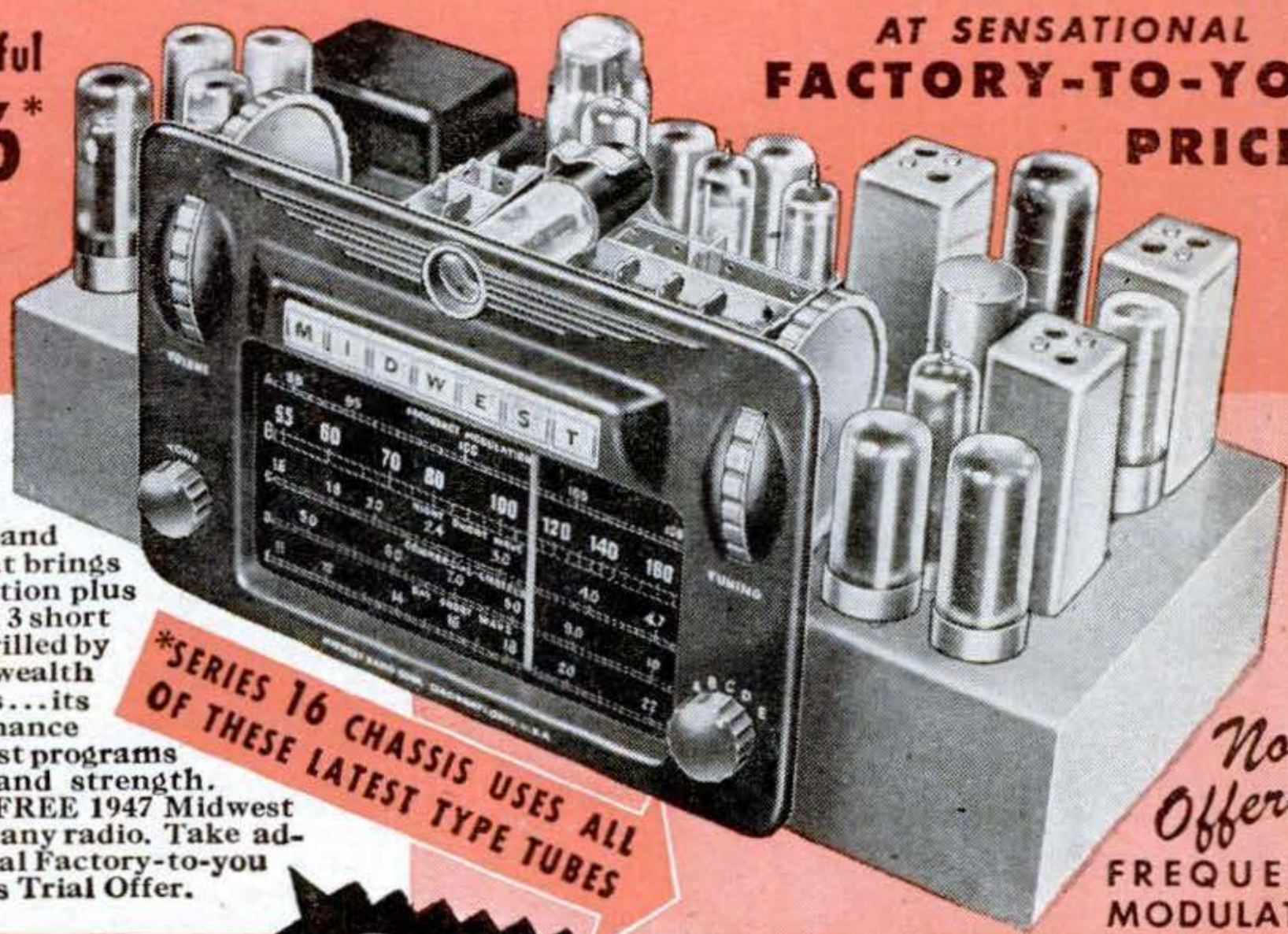

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*SERIES 16 CHASSIS USES ALL OF THESE LATEST TYPE TUBES

Now Offering FREQUENCY MODULATION

PUT THIS WORLD RANGING CHASSIS IN YOUR PRESENT CABINET OR SELECT A NEW **MIDWEST** FROM

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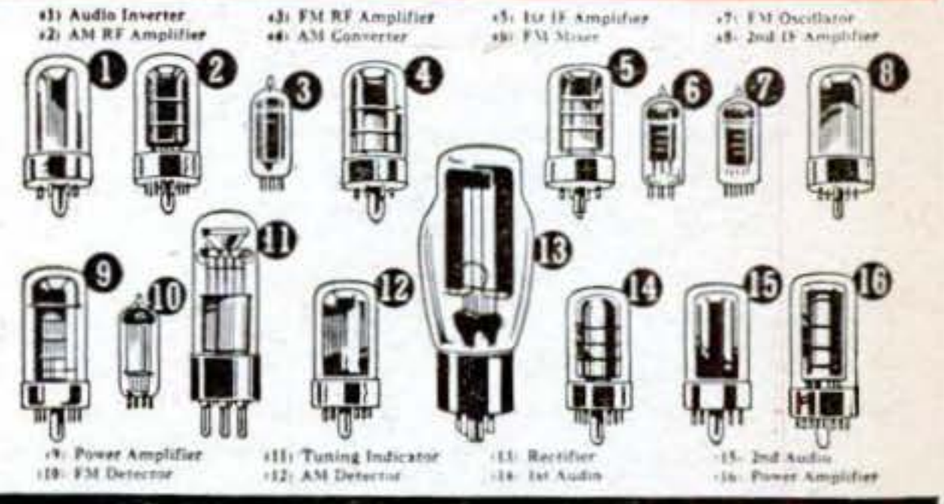

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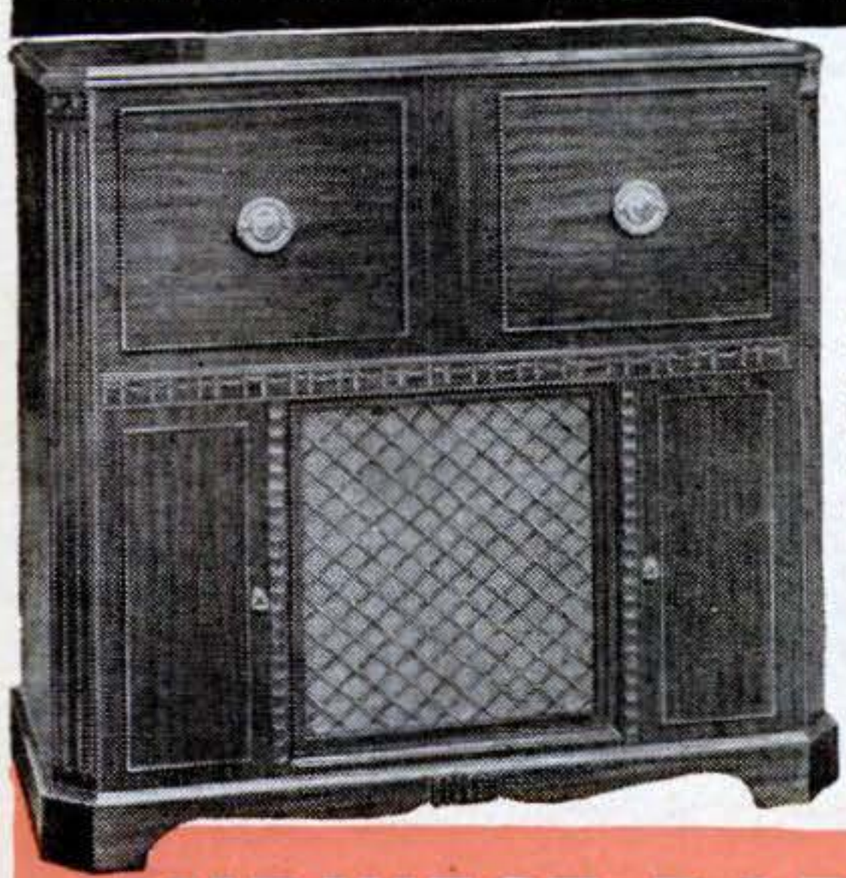

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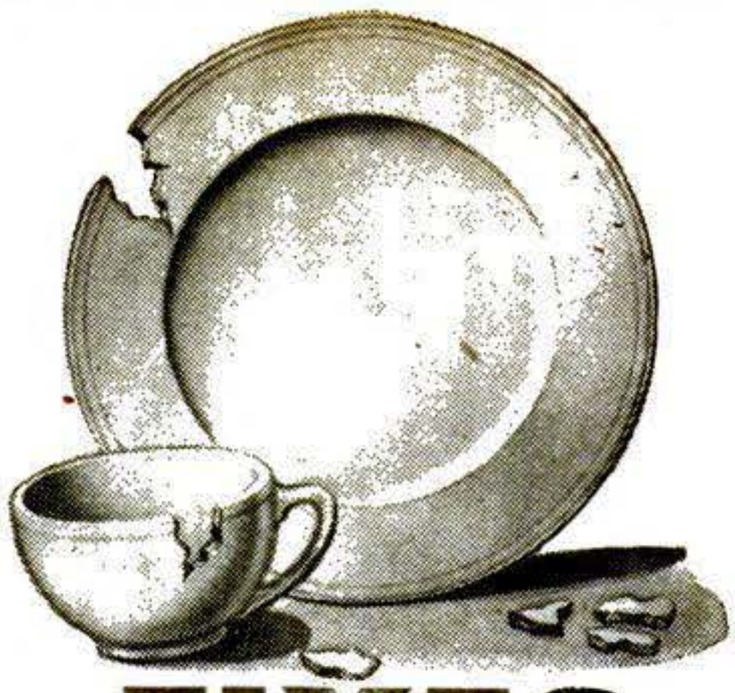

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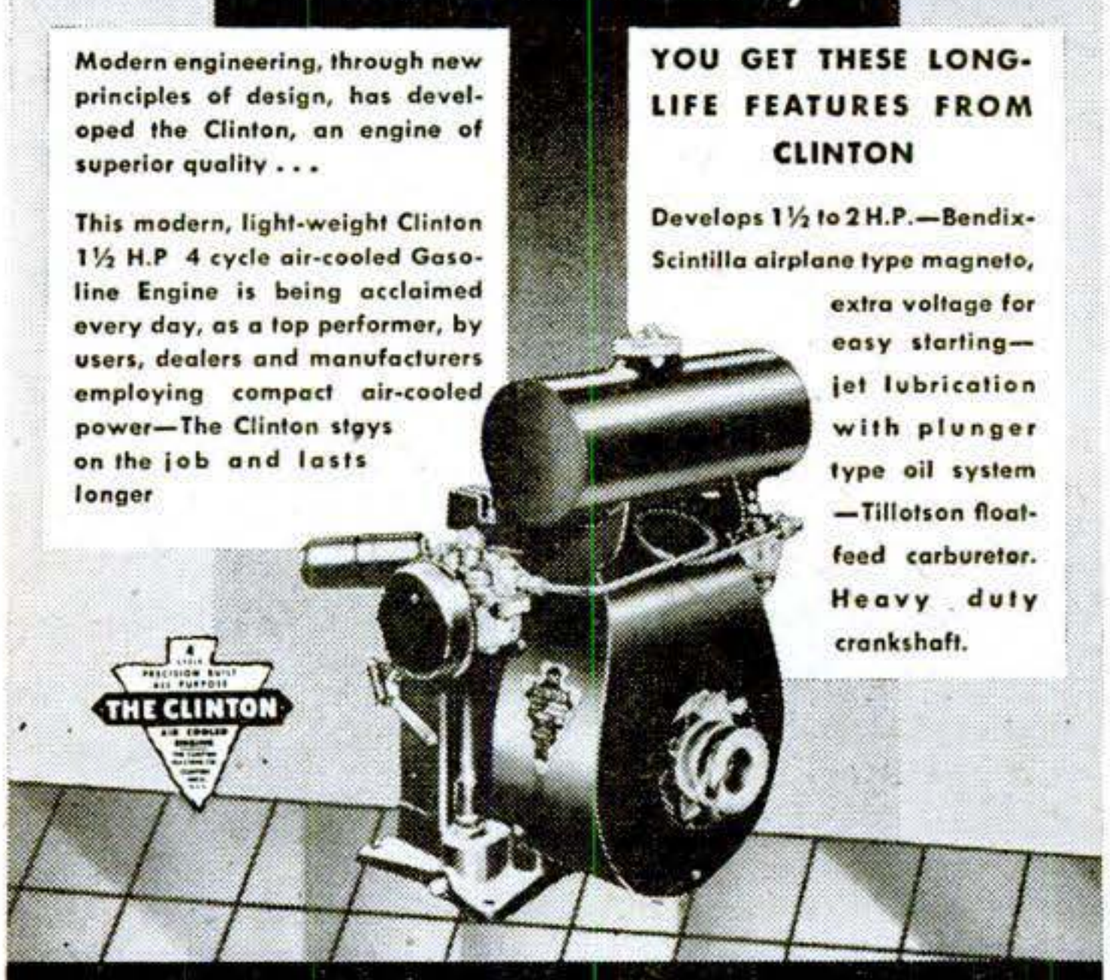

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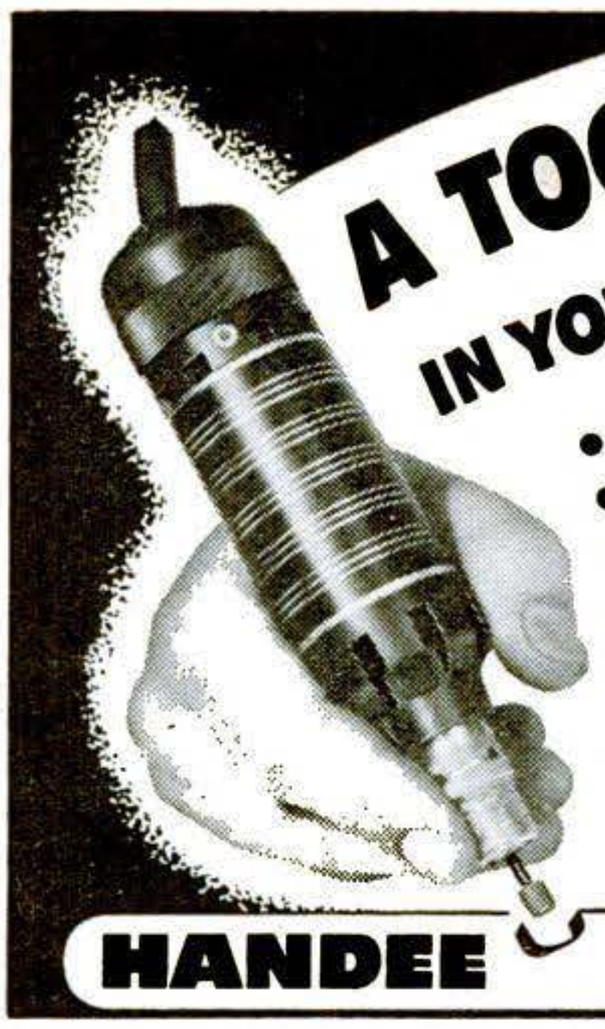

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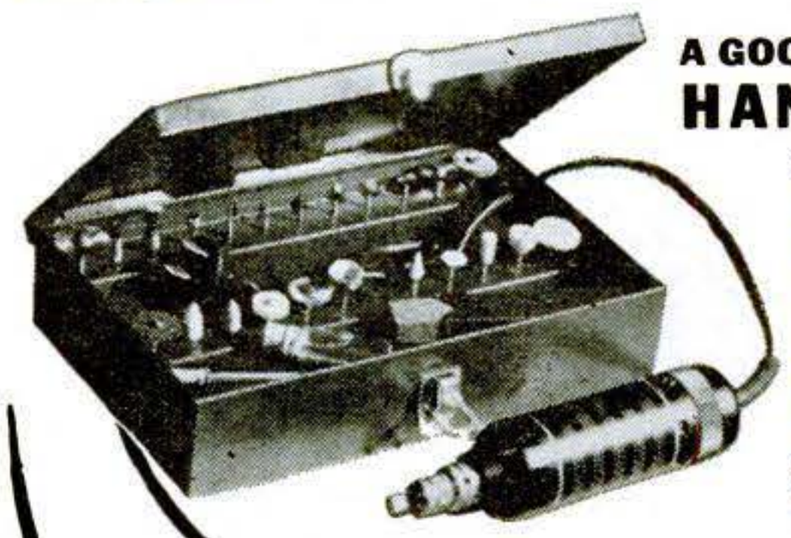

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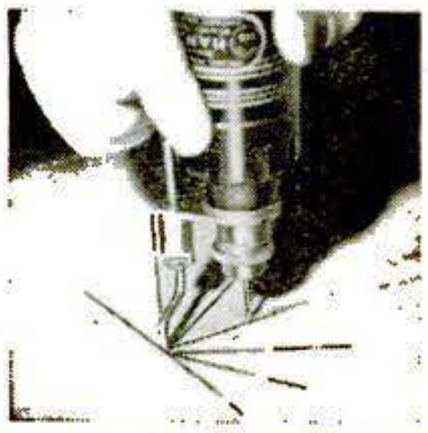

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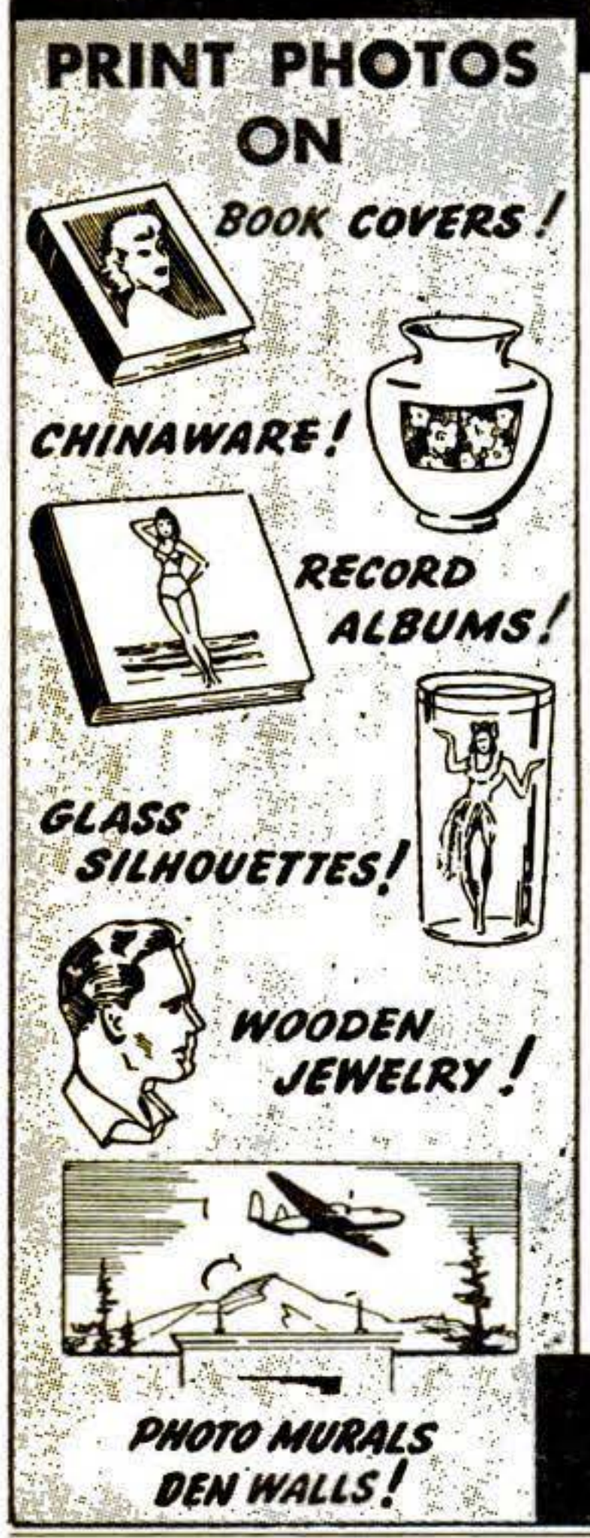

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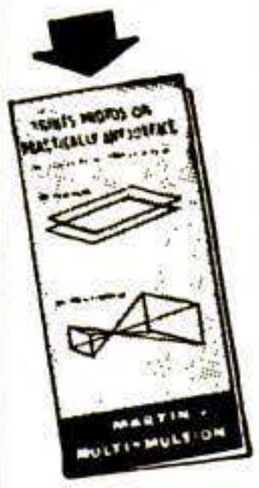

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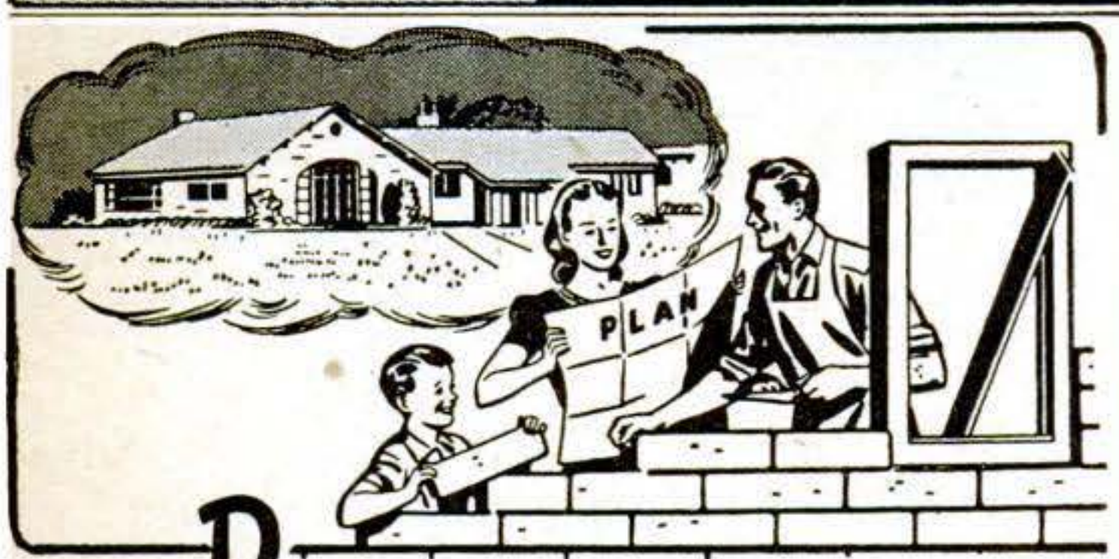

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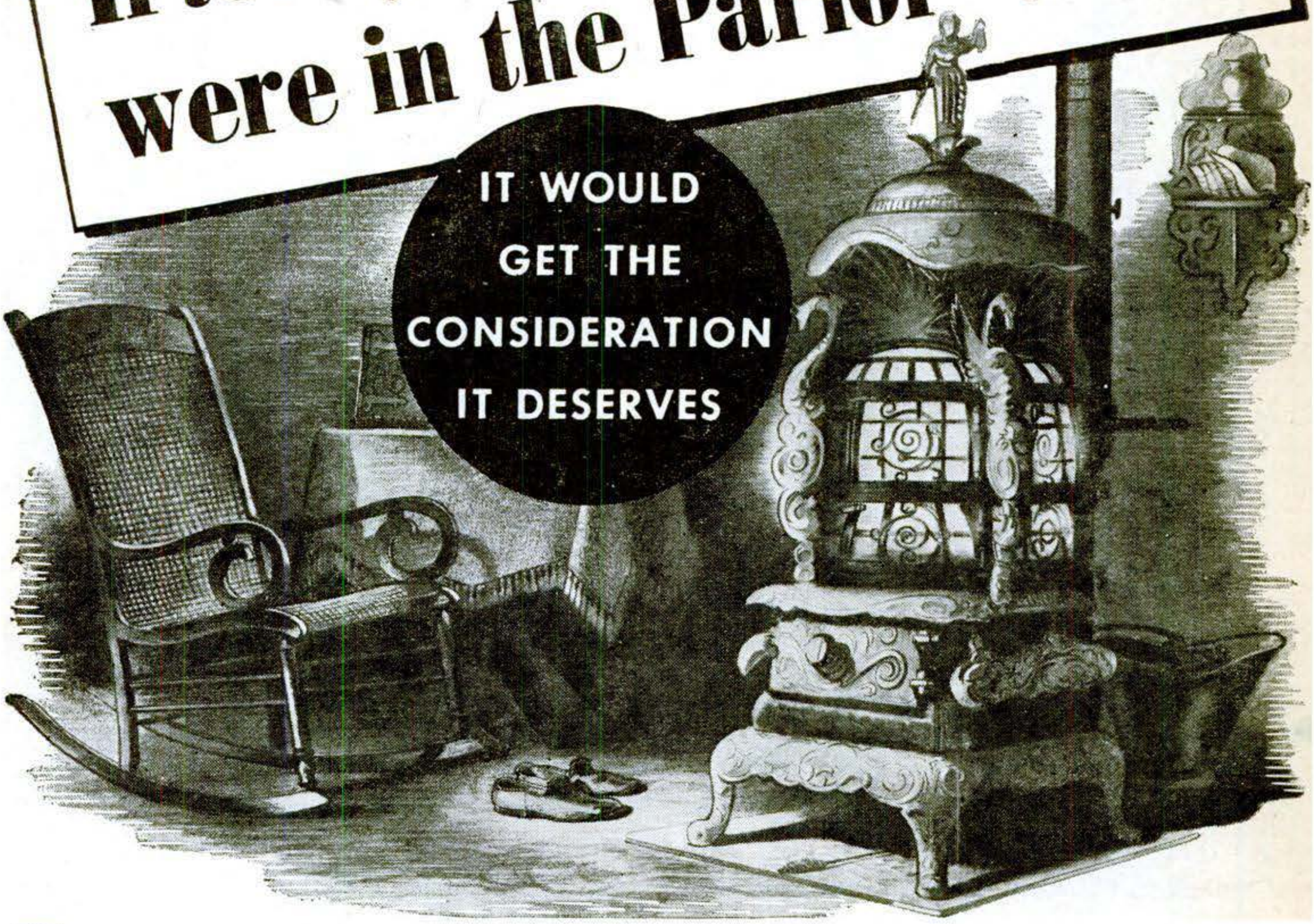

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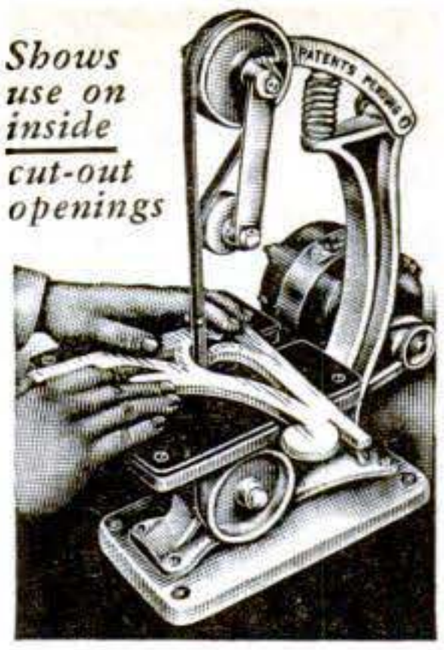

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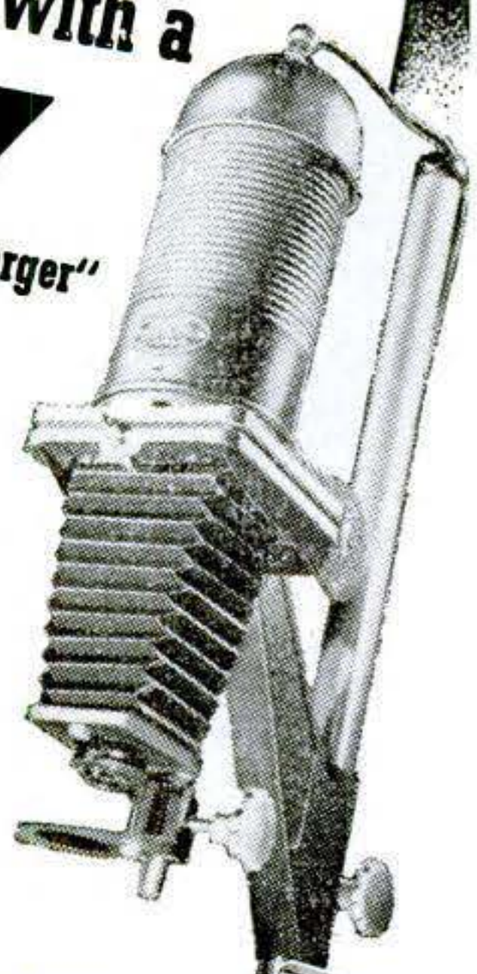

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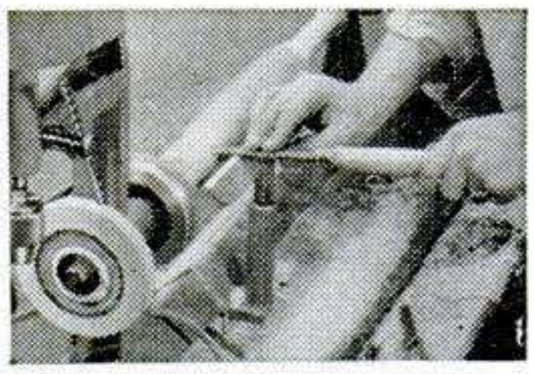

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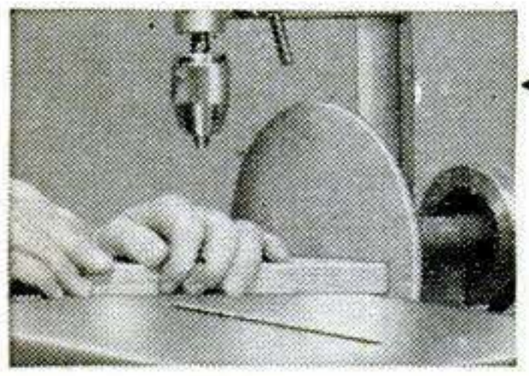

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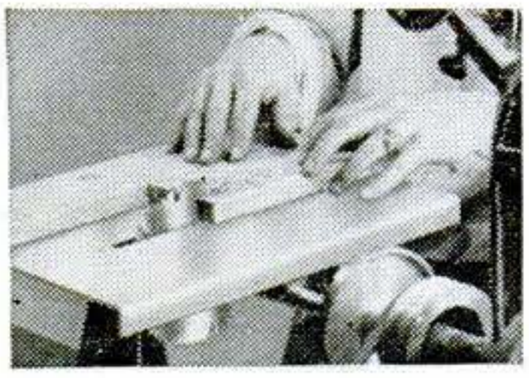

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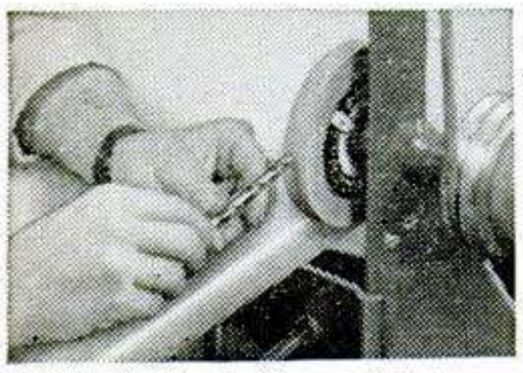

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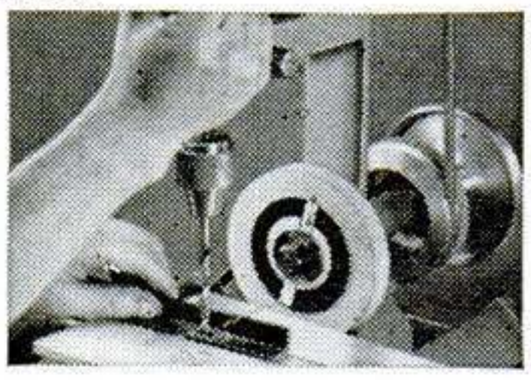

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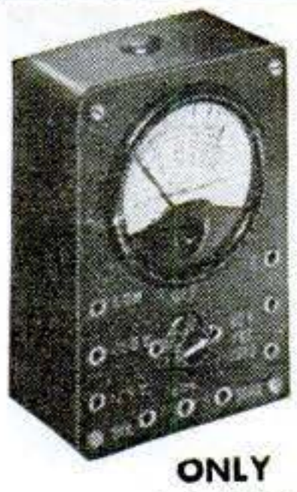

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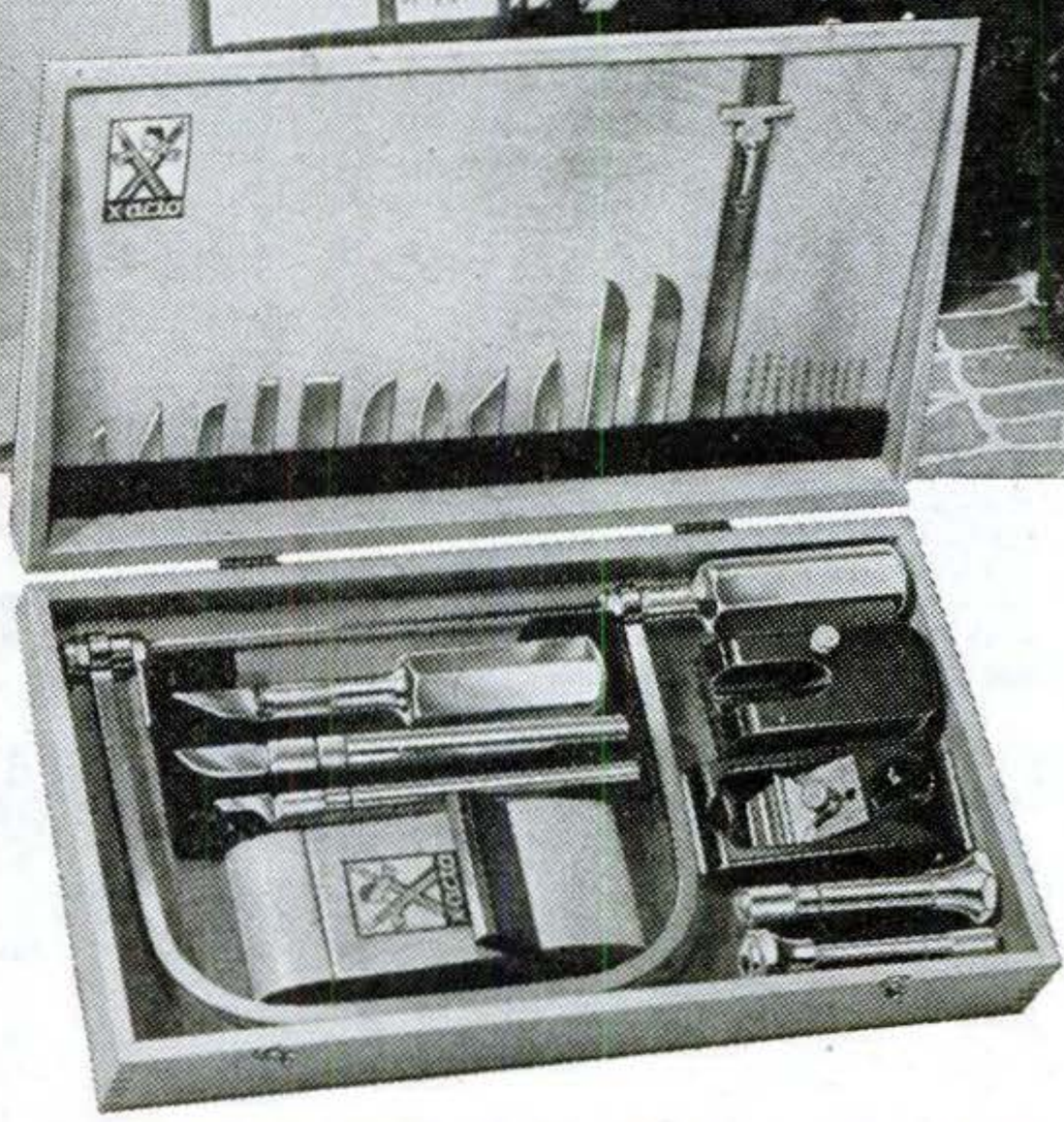

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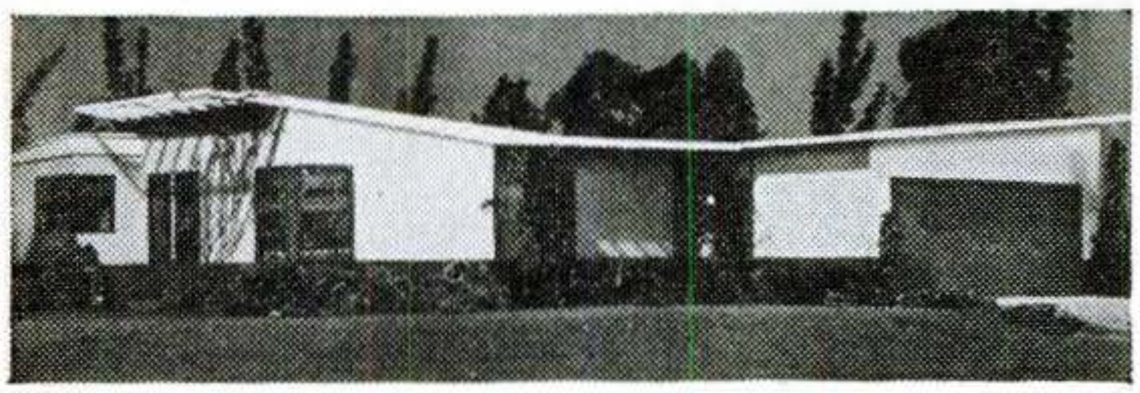
Thomas Galloway, model consultant, working on detail of scale-model miniature. "A No. 85 X-acto Tool Chest for every new employee's work bench" is on the schedule for this busy studio.



Models and Miniatures specializes in architectural layout, city planning and landscape models . . . often to as small a scale as one inch equals 16 feet. "X-acto is a *must* for every model builder," they say.

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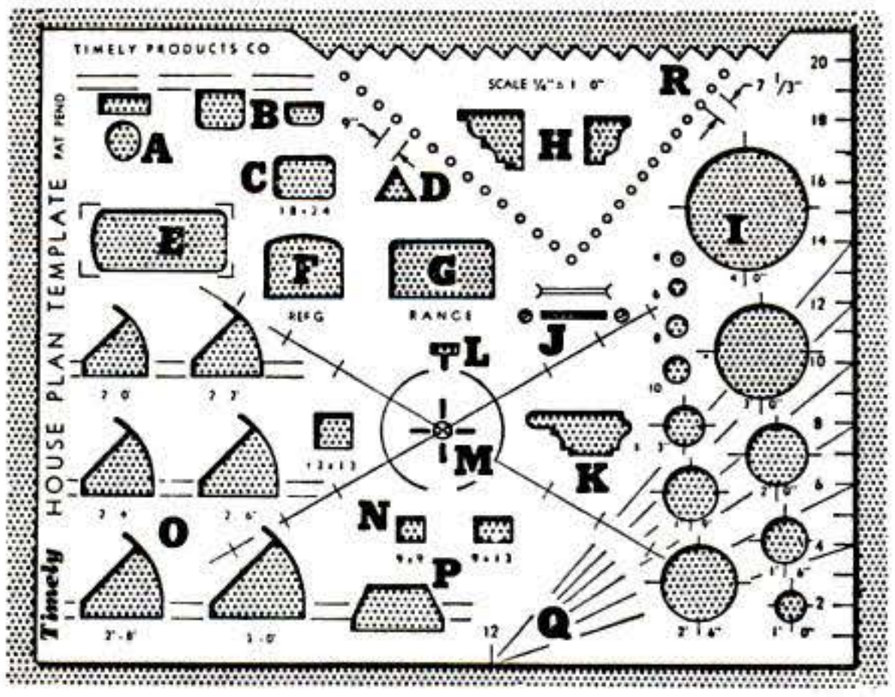

HOUSE PLAN TEMPLATE

Standard ¼"=1'-0" scale

- **A** water closet
- **B** lavatory
- **C** kitchen sink
- **D** reference notes, sizes, etc.
- **E** built in bath tub
- **F** refrigerator
- **G** kitchen range
- **H** moldings, gutters
- **I** circles for furnace, drains
- **J** fluorescent light symbol
- **K** moldings, stairs section
- **L** convenience outlet, electric
- **M** ceiling fixture, electric
- **N** masonry piers, flue liners
- **O** door swings
- **P** fireplace opening
- **Q** roof pitch gage
- **R** stairs

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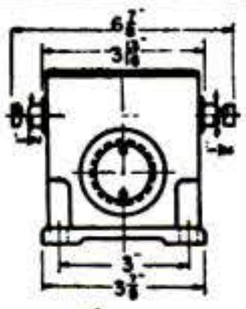

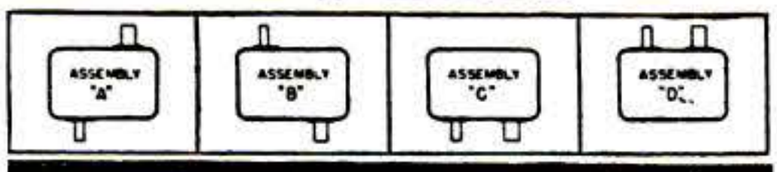

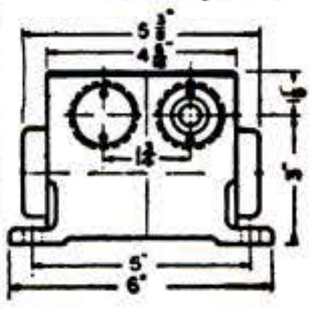

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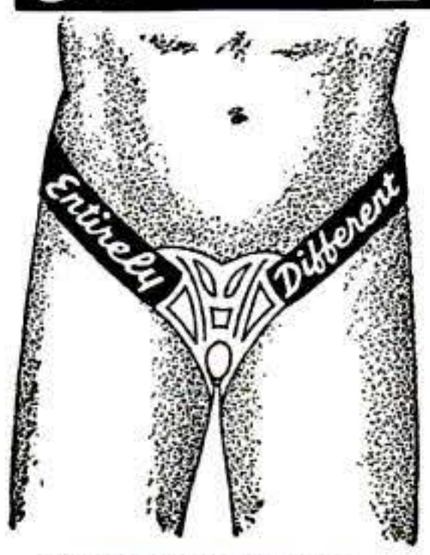

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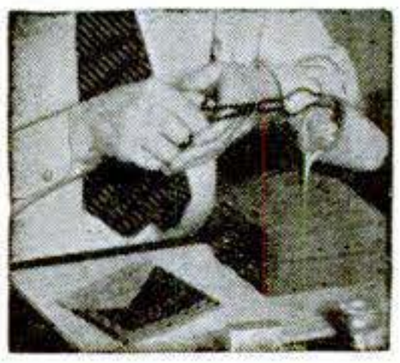

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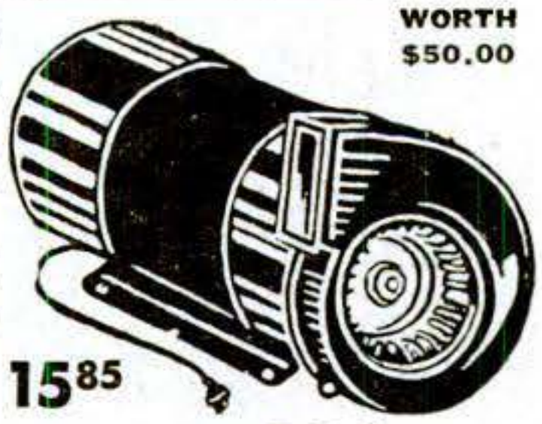

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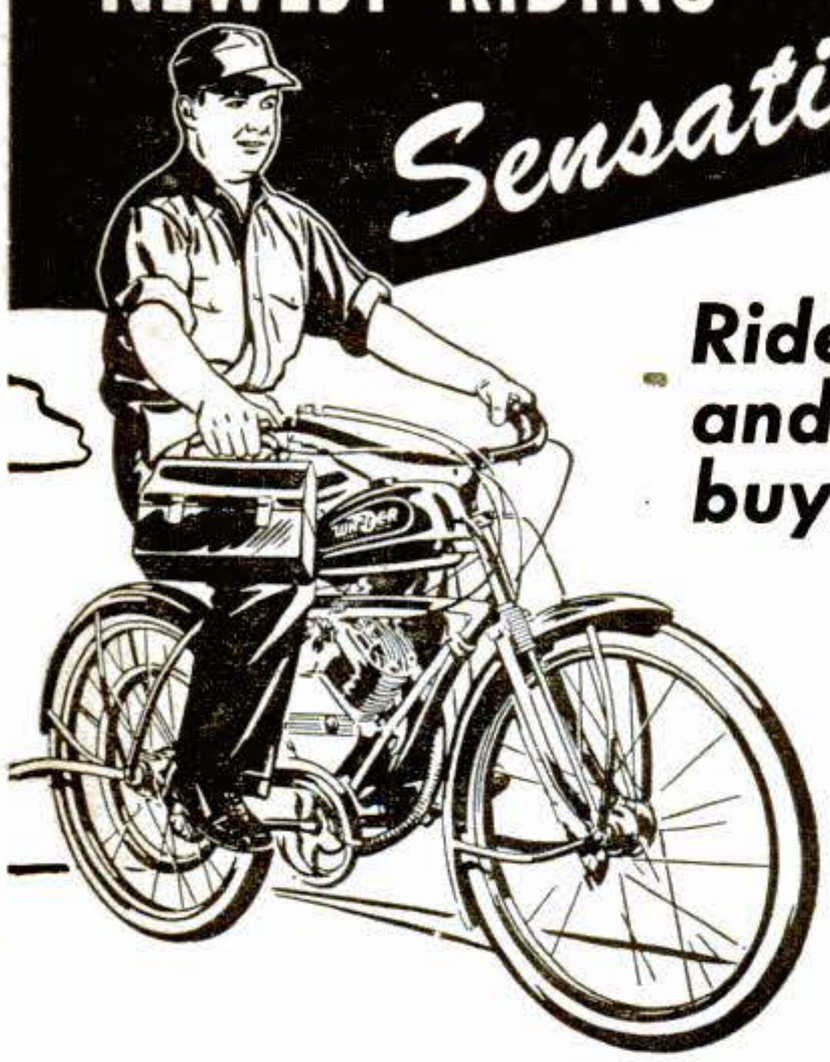

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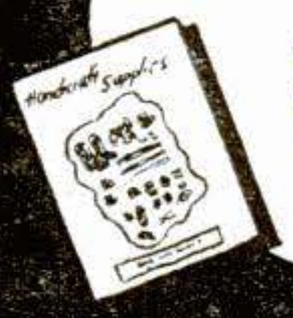

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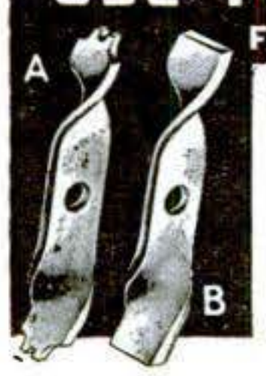

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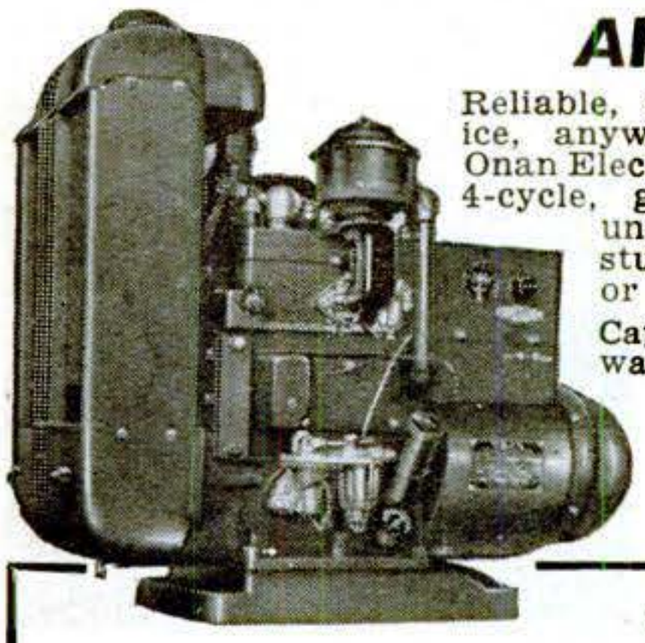

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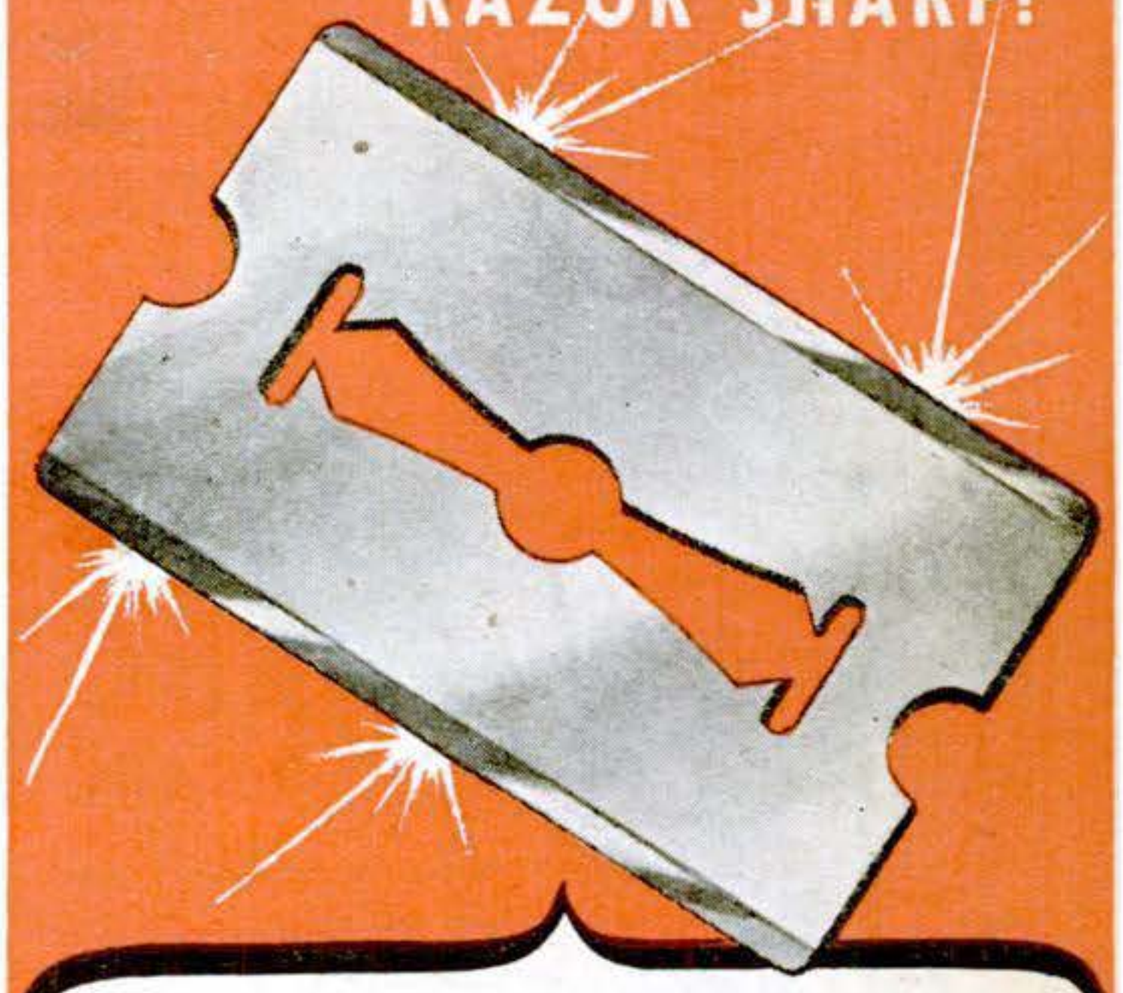

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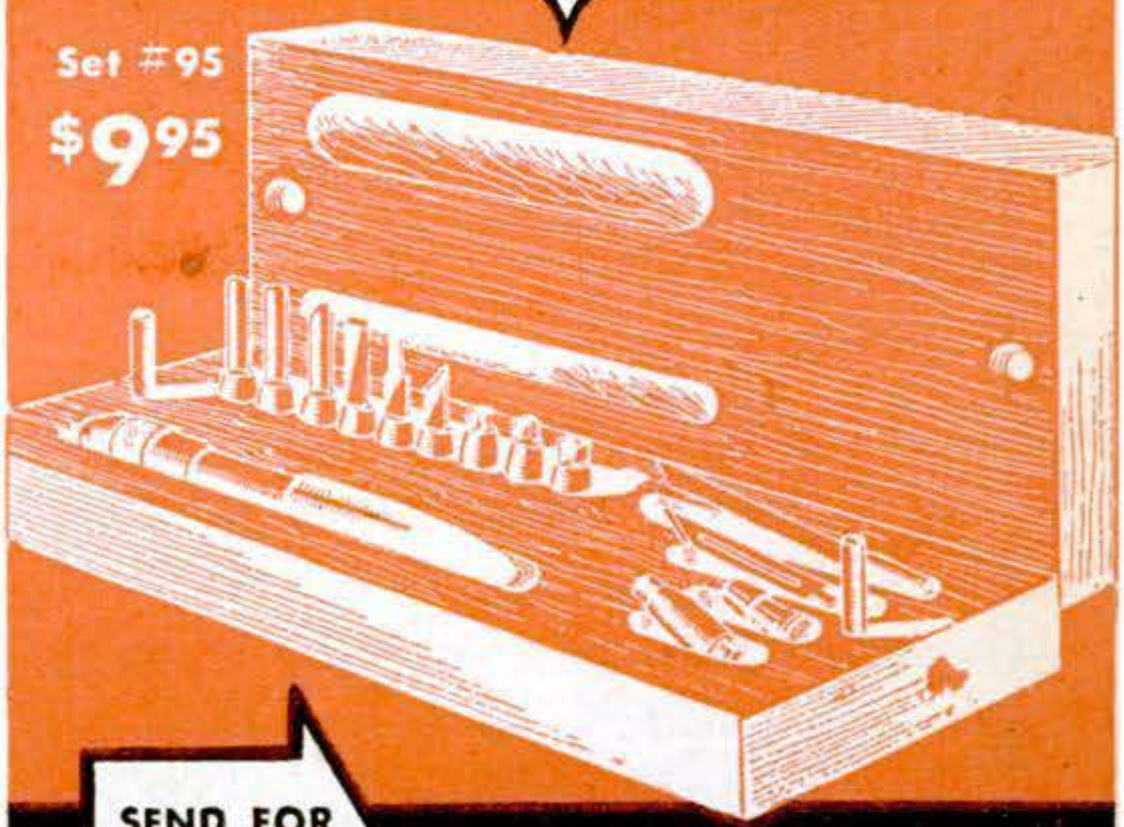

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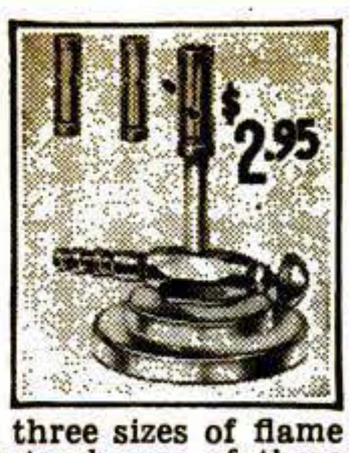

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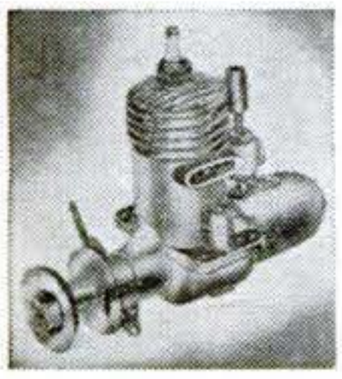

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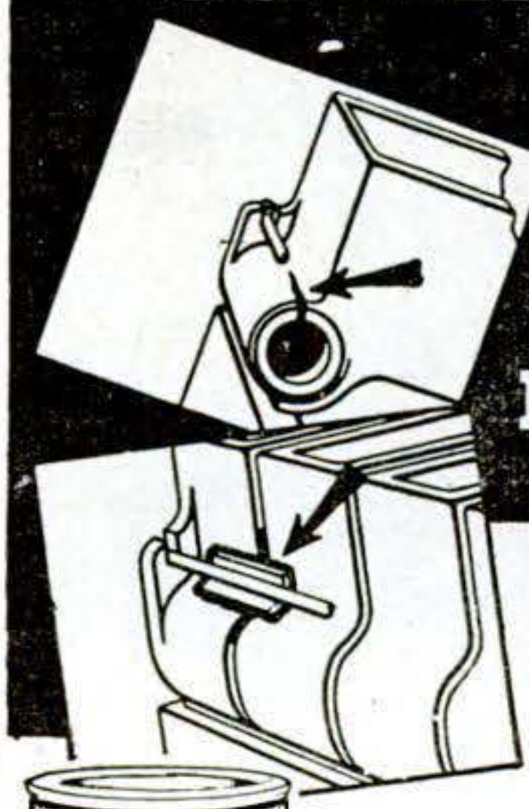

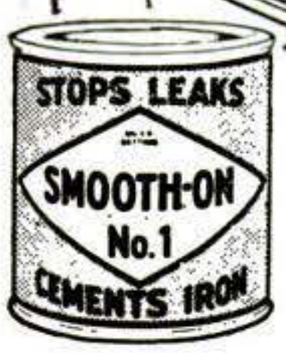

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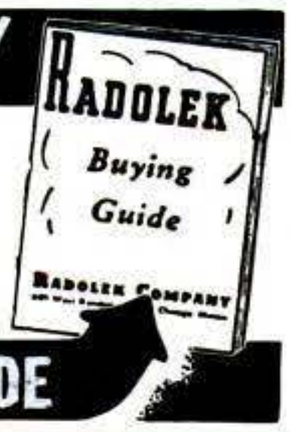

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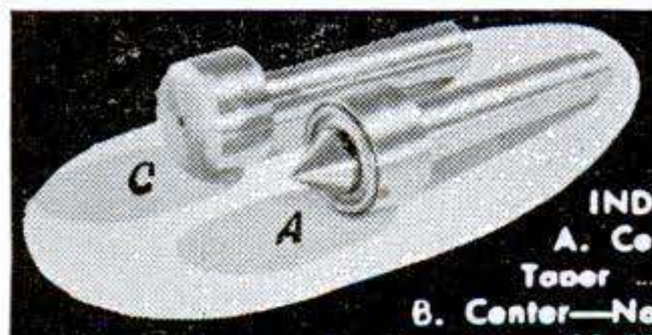

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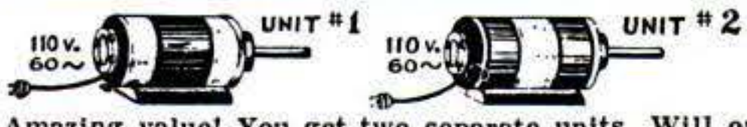

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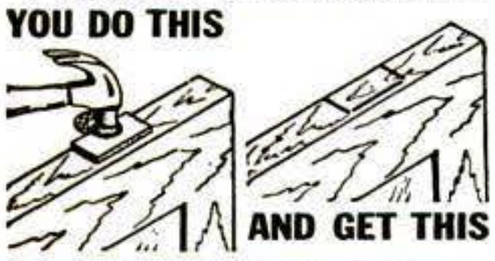

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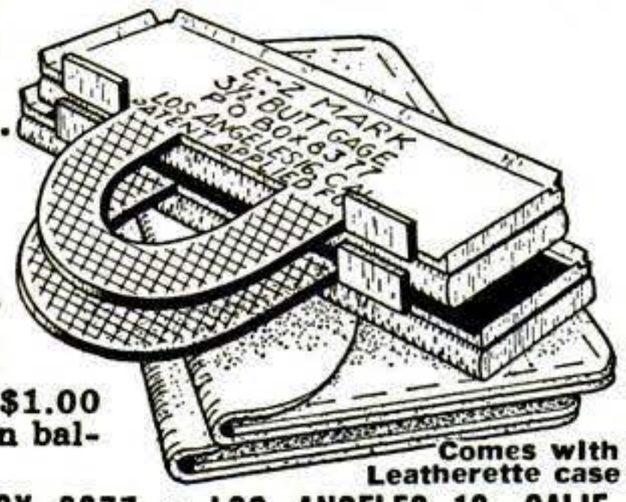

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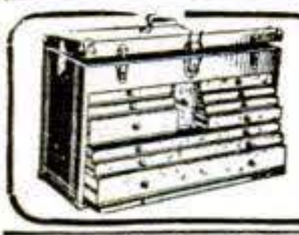

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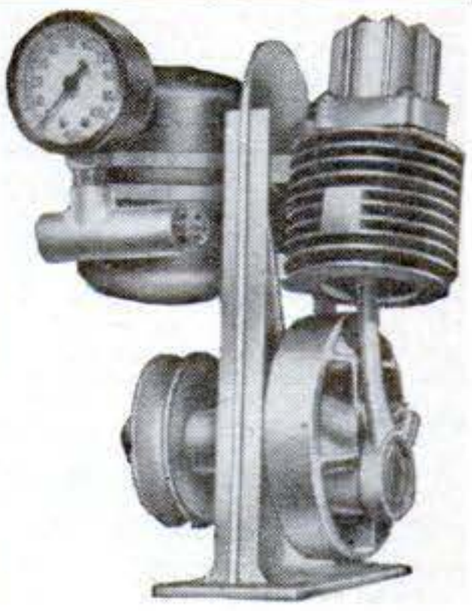

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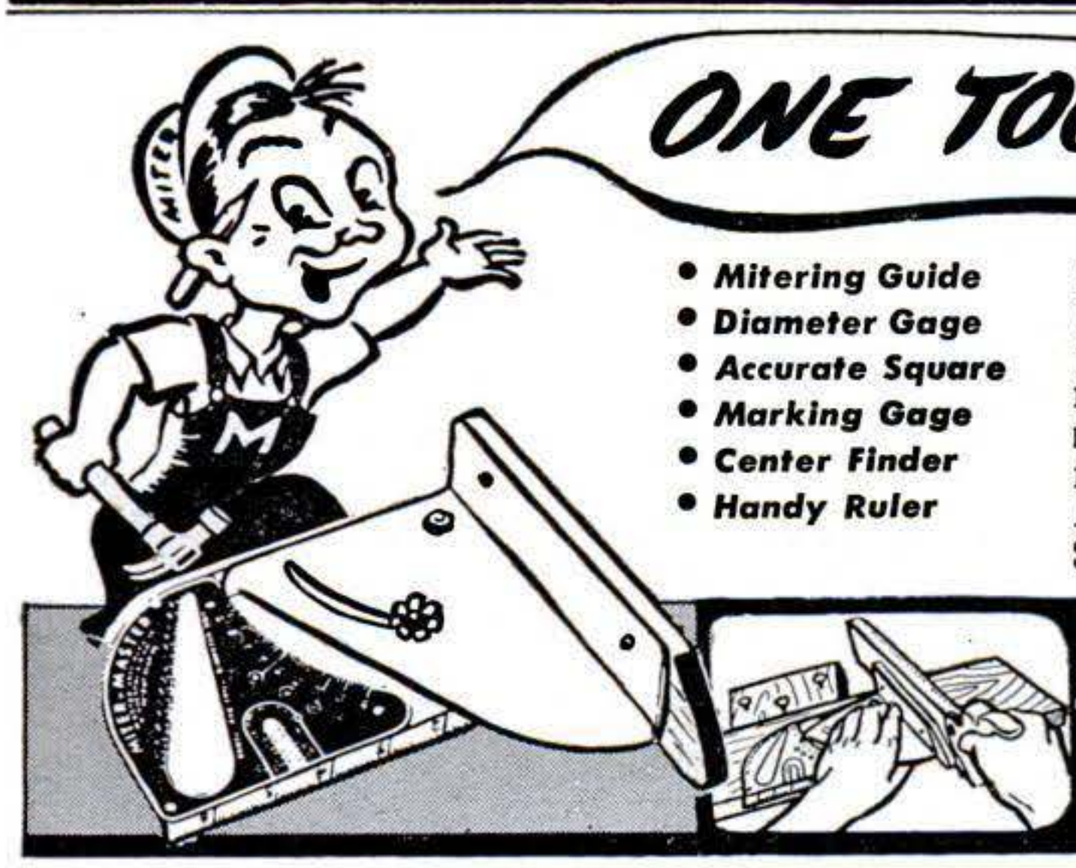

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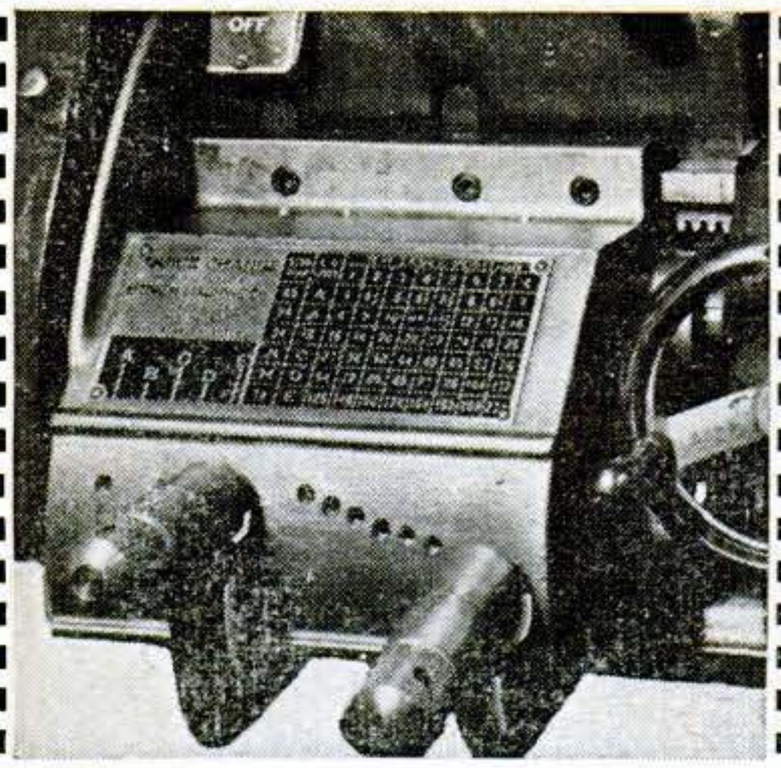

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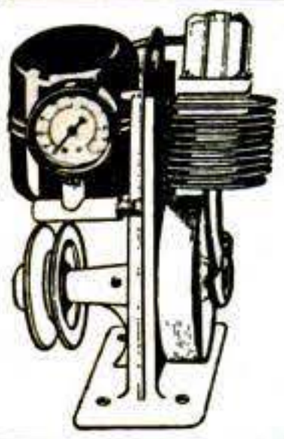

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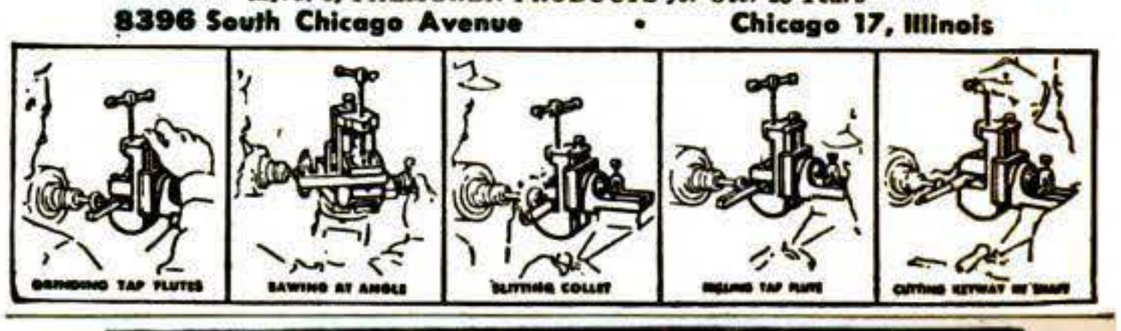

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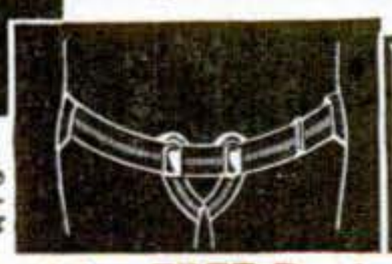

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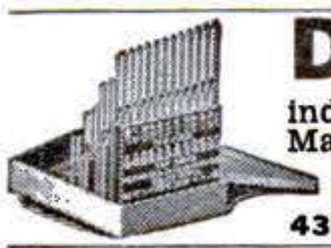

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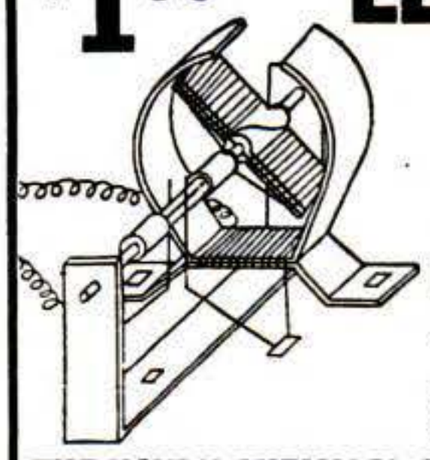

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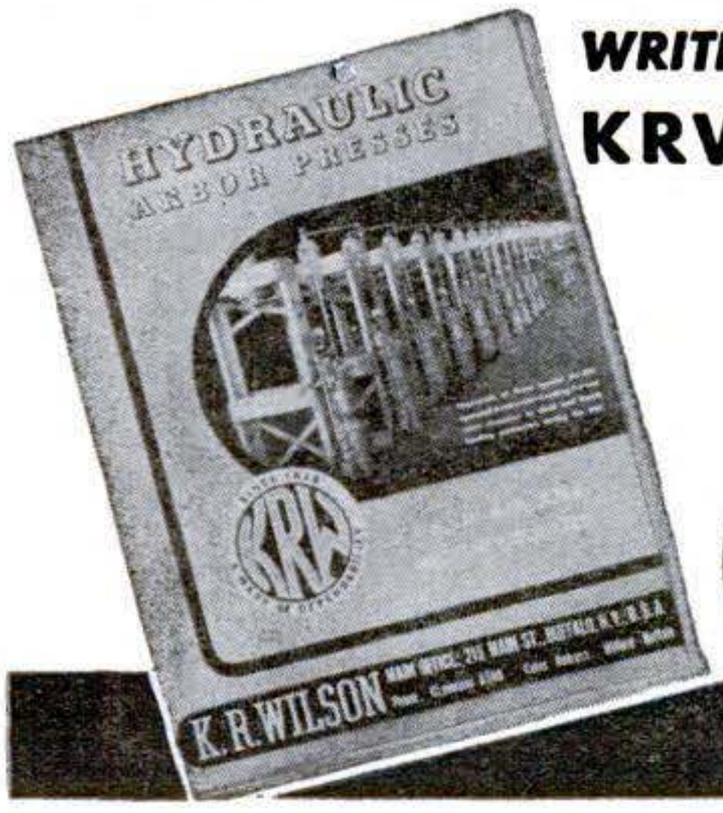

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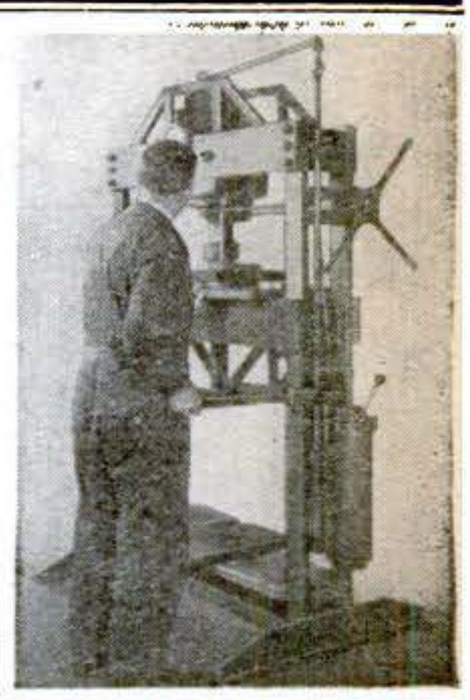

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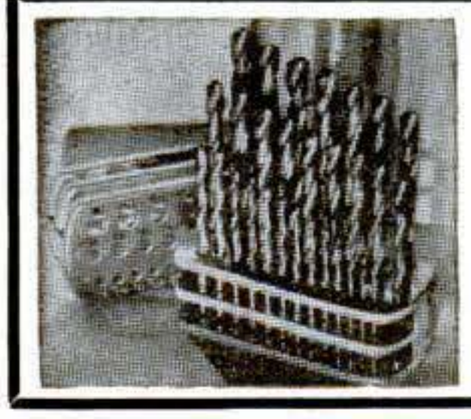

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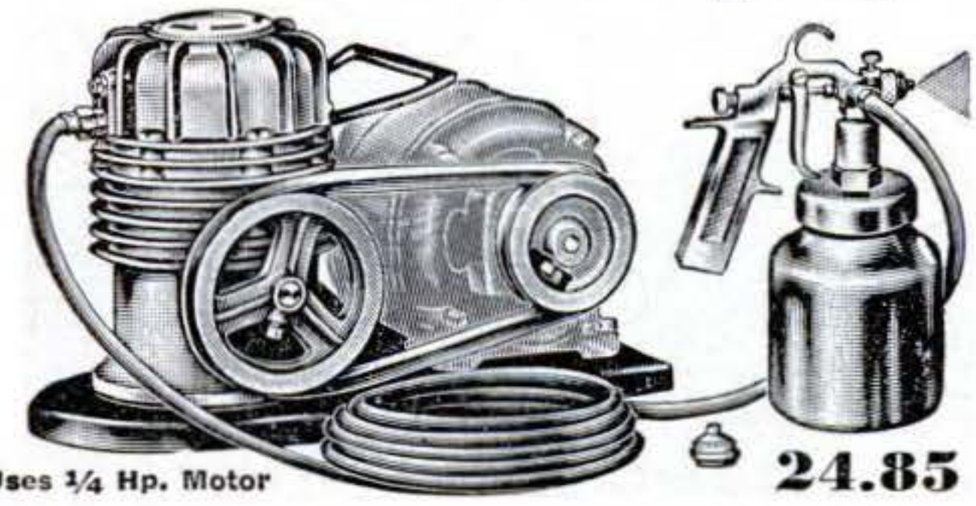

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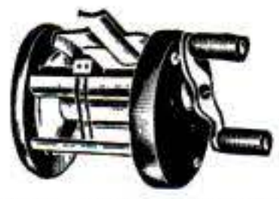

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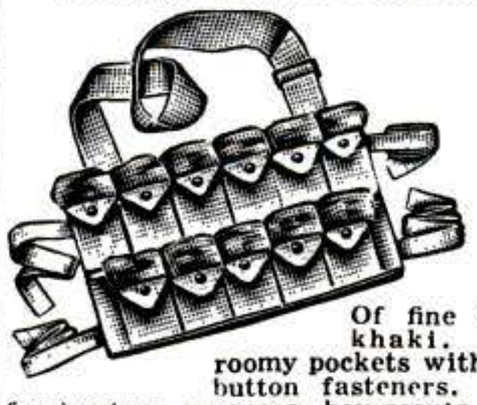

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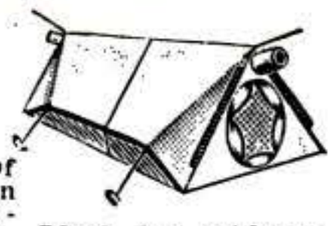

Regulation Army type two man mountain tent, complete with poles, guy ropes, etc. Of durable nylon with reinforced seams. Ideal for outdoorsmen, campers, etc. Shp. wgt. 10 lbs. A splendid value. **Stock No. 202.** Each..... **$9.95**

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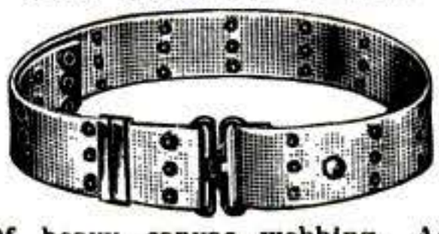

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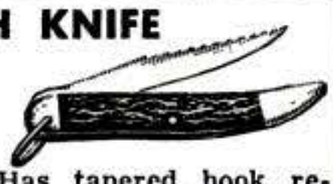

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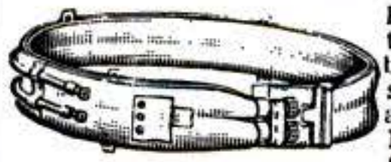

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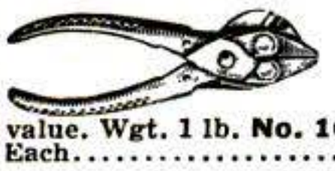

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KLONDIKE! For Hobby Jewelry Makers! Novelty Jewelry Findings from tables of large manufacturers—parts for Bracelets —Pins—Earrings, etc—unfinished. Chains —Rings — Pins — Stones — Clips — Beads —many other items—1 Lb. Bags—$2.00 Per Bag in 5 Bag Lots. Sample Bag—$3.00. Prepaid Only. Mdse. Distributing Co., 19 E. 16th St., New York 13.

EXCHANGE Your duplicate stamps, match covers, post cards, or any hobby, with collectors everywhere! Exchange register listing swappers, 10c. (Mention hobby). World Hobby House, Box 721-B, Olympia, Wash.

SWAPPERS' Hobbie Bulletin! Whatcha got? Watcher Hobbie? Trial two dimes. Royal Oak, Mich.

CAMPAIGN Ribbons—Beginner's Package —Introductory Price—50c, contains 15 Assorted Ribbons. Collectors desiring Special Ribbons specify your requirements. L.H.G. Company, 19 E. 16 St., New York 13.

UNUSED Match Book Covers. 100 all different $1.00. 35 Royal Flash Covers $1.00. Free list. Charles Edelman, 1311 P East 84, Cleveland 3, Ohio.

SWAPPER? Collector? Send 25c for sample copy. Hobbyswap Contacts, 1326 South 27th, Omaha 5, Nebraska.

HUNDRED dollars Cash—1,000 additional Prizes — Hobby * Contest, 2922 164th Street, Flushing 20, N. Y.

HOBBY Directory—an adventure in sharing hobbies and making friends. Box 91, So. Orange, N. J.

FAMOUS art reproductions for album collections. Framing. 15 for $1.00. Saur, 127 West 82, New York 24, N. Y.

BIG Money in Wirework. Learn How to make fast selling wire novelties, names, swords, earrings, bracelets, etc. Descriptive copyrighted booklet, over 200 diagrams, one dollar. Lee Brandywine. 69 Bay 29 St., Brooklyn, N. Y.

8 ANTIQUES, RELICS, INDIAN GOODS

SWORDS, rapiers, daggers, pistols, armor; illustrated catalog. 50c. Robert Abels. 860½ Lexington Ave., N. Y.

4 FINE perfect Ancient Arrowheads $1.00. 4 perfect tiny bird arrowheads $1.00. List Free. Lear's, Box 569, Galveston, Texas.

350 ANTIQUE Firearms;—3,000 Bargains: Indian Relics, Flintlocks, Minerals, Coins, Swords, Cartridges, Fossils, Rifles, Carbines. Catalog-Photographs 25c. Heike, Wenona, Ill.

40 CURIOS

MINIATURE Leather saddles $4.98 postpaid, cash M.O. Kruces Kreative Kraft, Box 42, Las Cruces, N. M.

85 MINERALS & PRECIOUS STONES

FIFTY mineral specimens, boxed, mounted, identified, described. Postpaid $4.00. Old Prospector, A-25, Dutch Flat, Calif.

GEMS, precious and semi-precious, all genuine from world wide sources. Deal direct, no overhead, save money. Catalog 10c. Hill Co., Route 7-K, Salem, Oregon.

GEM Cutters, beautiful agatized wood, assorted colors, two pounds, one dollar. Thirty cents postage. L. Manning, Hettinger, N. Dak.

FOUR useable samples of unusual ebony-like Alaska petrified wood $1.25 Post Paid. Alaska Specialty Supply Company, Box 1081, Petersburg, Alaska.

WANTED Rocks. 20c Rock. James Esposito, 682 Garfield, Hazleton, Pa.

26 CAMERAS, PHOTO SUPPLIES

CASH! Spot cash for cameras, lenses, binoculars, movie and still equipment. Send full description for prompt cash offer. Over 36 years of dependability. Bass Camera Co., Dept. SP, 179 W. Madison St., Chicago 2.

USED Camera Directory, Box 1031-K, Canton, Ohio—lists hundreds of War-Bargain Used Cameras—35mm, Speed Graphics, Kodaks, Rolleiflex—many others. Send 25c for latest issue.

HAVE you a camera. Improve your hobby of photography and learn how to make better pictures. Write today for our latest book catalog and sample copy of American Photography, containing articles and pictures by the world's foremost writers and photographers. Camera House, 603, 353 Newbury St., Boston 15, Mass.

BASS Says: Trade Cameras? For 36 years Finest equipment available. Always Satisfaction Guaranteed Or Your Money Back! Bass buy 'em, trades 'em. Bass Camera Co., Dept. SP, 179 W. Madion St., Chicago 2.

PHOTOGRAPHY for pleasure or profit. Learn at home. Practical basic training. Long established school. Write for booklet. American School of Photography, 1315 Michigan, Dept. 1741, Chicago 5.

SPEED-O-COPY groundglass focusing attachment for Leica, Contax, Argus C-2, C-3. Send for literature, D. Paul Shull, Dept. PS-1, 240 S. Union Avenue, Los Angeles, California.

ART Studies of Hollywood's most beautiful models! 200 masterpieces of the female figure! For adults only. Available as: Slides for projector or viewer, and fine grain Negatives for enlargements of any size. Prices: 2" x 2" Color Slides 10 for $4.00. 2" x 2" B & W Slides 10 for $1.50. 35mm Negatives 10 for $1.00, 100 for $8.00. All different! Colorcraft, 1302-A, Broadway, Burbank, Calif.

CAMERAS—movie projectors — enlargers —free catalog. Cavalier Camera, 1822 Center, Pittsburgh 19, Pa.

SPEEDLIGHT Equipment, parts, data available from pioneer manufacturers Lee Strobospeed. Limited quantity A. C. and battery portable units special yearend clearance prices. G. E. Lee, Sylvania, Hytron, Amglo, Flashtubes Stocked. Irvin Aaron Associates, 3617 Greenbay Avenue, Milwaukee 12, Wisconsin.

102 PHOTO FINISHING

SENSATIONAL introductory offer! Send snapshot or negative, this ad, and 3c. We'll send you a beautiful 7" x 5" enlargement! Or, Kodak roll developed with 16 guaranteed deckle-edge velox fadeproof prints or 8 double-size prints, 25c! Special! From your negatives, 16 regular-size or 8 double-size reprints 25c! Candid Rolls—36 exp. 35mm developed, vaporated, enlarged to 3x4, $1.00! 18 exp. 50c. Reprints, 3x4, 3c each. We have new, perfect 35mm film. Low prices. Free Mailer, details on request. American Studios, Dept. 280, La-Crosse, Wis.

BIGGEST $1.00 value in 35 MM finishing today. 36 exposure fine grain 3¼x4½ enlargements; deckled, embossed margin and date. Eighteen exposures 75c; 16 exposure splits 55c; 36 exposure reloads 50c. Special: return this ad with $2.00 and we will send five 36 exposure reloads. Free mailers. 8 exposure rolls in beautiful, deckled contact finish with embossed wide margin, 25c. Mailbag Film Service, Box 5440-A, Chicago 80.

ROLL Developed Printed 20c. Reprints 50 for $1.00. Howards, 3760 Fremont, Chicago (13).

BEAUTIFUL 4 x 6 enlargements, a .75c value for only .30c a roll. Photo Service, 107 Dewy St., Newark, N. J.

GORGEOUS Color prints for your transparencies, 4x5—$1.00, 5x7—$1.98, 8x10—$2.98. Broad Camera, 953 Broad St., Newark, N. J.

FREE—Set of filters for names and addresses of four camera owners. Photo-Craft, Canton 1, Ohio.

BEAUTIFUL enlargement from each picture on roll 25c. Cut Rate Photos, Dept. A-6, Janesville, Wis.

AT Last: We Have Films: 116 & 616—38c ea., 120 & 620—33c ea., 127—27c ea., 8 exposure roll developed, all your snapshots hand-colored as beautiful as most actual colored photography—50c. Hand colored reprints—6c each. 8 exposure roll developed and black & white prints—35c. Reprints—4c each. Midwest Photo, Janesville 27, Wisc.

PHOTO statuettes $1.00. Send negative, money. Suburban, 1410-S Bond, Rockford, Illinois.

8 DOUBLE-size prints, 30c. Pre-war quality. Quick service. Willard's, Box 3506F, Cleveland, Ohio.

TWO beautiful prints from each picture on roll 25c. Twenty five years of satisfied customers. Quick Service. Lens Photos, Dept. J-9, Janesville, Wis.

ROLL Developed 8 brilliant fadeproof Velex prints and two Professional Enlargements 25c. Overnight service. Young Photo Service, 406-C Albany 2, N. Y.

ANY Offer 35c—8 x 10 Framed Enlargement. Three 8 x 6 enlargements. 12 Prints plus one 8 x 6 enlargement. Six 4 x 6 enlargements. Roll developed, 16 prints plus one 8 x 6 enlargement. Photo album plus 100 Art Corners. Prompt, guaranteed. Lifetone Photo Co., Dept. 18, Des Moines, Iowa.

PHOTOGRAPHY for pleasure or profit. Learn at home. Practical basic training. Long established school. Write for booklet. American School of Photography, 1315 Michigan, Dept. 1722, Chicago 5.

PENNY Photos — Marvelous machine brings top quality, lowest prices. 20 Reprints 25c; 50 or more 1 cent each. Penny Photos, Box 904, Des Moines, Iowa.

8 exposure rolls developed with one each and a free enlargement, 25c. Over 8, with enlargement, 40c. Reprints 3c. Fred A. Eastman, Bode, Iowa.

ROLL developed and 8 prints 30c. Overnight Service. Free Mailers. Tri-Plex Photo Service, Box 375, San Francisco, Calif.

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YOUR films deserve expert attention. Quality Photo Finishing Deckel edge Velox paper. Any 6 or 8 exposure roll 25c contact size 35c double size. Mail Back Photo Service, Box 505, Buffalo, New York.

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104 PHOTOPRINTS, PHOTOCOPIES

PROFESSIONAL 8x10 Enlargements: Fine Portrait likenesses of your favorite picture, Artistically finished in golden sepia and mounted in beautiful frame, $2.95. Arden Studios, Franklin Park, Illinois.

UNIQUE Photographic Subjects Lists. 20 samples $1.00 prepaid. Copyphoto Service, 1146 Jefferson, Oakland 7, California.

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HOLLYWOOD Films! Sample and catalog 10c. Stone, Lunenburg 10, Mass.

UNUSUAL home movies: Travel, adventure, sports, comedies. Silent-Sound. Many film bargains. Big illustrated 1947 catalog, sample-dime. Audet, Box 6520-AG, Philadelphia 38, Pa.

BEAUTIFUL Models in 20 new, daring subjects. 100 feet 16mm, $5.50. Immediate delivery. National Cinema Service, 71 Dey Street, New York 7, N. Y.

MOVIE Camera Films, 100' 16mm $2.50. 25' double 8mm. $1.25. Free Developing. Better Films, 742 New Lots, Brooklyn 7, N. Y.

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GUARANTEED Fresh anti-halo outdoor movie film! Daylight loading! Processing free! Three spools Double 8mm, $3.45! Six single 8mm for Univex, $4.60! Postpaid! Catalog. ESO-S, 828-A, West 39th, Kansas City 2, Missouri.

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MOVIES for whole family. 8-16mm. Projection length Kodachrome sample—dollar. Kodachrome sample, lists, dime. Campus Films, 668-C, Ithaca, N. Y.

16mm. SOUND films. Complete subjects, good condition, often as low as $1.95 per 400' reel. Write for list of over 200 available titles. Blackhawk Films, Davenport, Iowa.

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16 35mm SILENT Sound Films Projectors. Bedner, 5300 So. Talman, Chicago.

HOME Movies. Rent-buy-swap 8/16mm silent and sound at money-saving rates. Details for a dime. Midland, Box 429, Oak Park 3, Ill.

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THE Newest 16mm. Sound Rental Service! Schools—Showmen! No cards. Letter describing your use of 16mm will bring catalogue. Popular Pictures Exchanges, Traverse City, Michigan.

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"THE World's Greatest Passion Play". All sizes. Rent or Purchase. Write Hemenway Film, 33 Z Melrose St., Boston 16, Mass.

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FREE Catalog: Movie, samples 10c. Photographic Supplies. Goodwill Company, Jackson, Tennessee.

JOIN World's largest Cinematographic Society. Details Free. International Society Cinematographers. Suite 118, 6770 Hollywood Blvd., Hollywood, California.

16mm MOTOR Driven Projectors—$16.00—Up. Selco Products, Denvers, Massachusetts.

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MAKE Your Own Big Enlargements!! Build this efficient enlarger with inexpensive materials. Plan, Picture, & Photostat $1.00 Photoaid Products, 5558 E. Harvey Way, Long Beach, Calif.

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USE prof. copies, leadsheets, choruses to push your song. Send copy for prices. Humphries Co., Music Printers, Austin, Texas.

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REAL Composer of Music will co-operate with lyric writers in song production. Fine publication proposition. Nationwide distribution of publications. Recordings Made, Copyrights secured. Write Now. C. Isabel Mayer, Box 3896, Portland 8, Ore.

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FLAT rate schedules improve profits, compiled from 500,000 jobs. Write for information. Radio Equipment Co., 1415 W. Franklin Ave., Minneapolis 5, Minn.

BUILD Simplest One-Tube AC Radio. Instructions: 25c. "All About Crystal Sets," Booklet, 50c. "Loudest" Crystal Set Instructions, 25c. Amoroses, Route Four, Richmond, Virginia.

1947 REVISED "Plans 18 Crystal Sets" (SW record 5800 Miles), Catalog, "Radiobuilder"—25c. 6 issues "Radiobuilder" —$1.00. Laboratories, Box I-t, San Carlos, California.

RADIO Tubes—Attention Radio Repair Service Men. For satisfaction in Radio Tubes, Le-Hi Electrical Co., 660 Broadway, Newark 4, New Jersey. Distributors of guaranteed Radio Tubes.

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LEARN Radio At Home. Earn money. Have fun building our "Educational Radio Kits." We teach you every step. Simple, easy to understand instructions. Free literature. Write immediately. Chapin Electronics, Inc., Dept. B., 134 W. Onondaga, Syracuse, New York.

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HAVE your own office! Learn new profitable business in uncrowded field. No selling. Many earn up to $5,000-$15,000 yearly. Write for Free details. No obligation. No salesman will call. Franklin School, Dept. 203-A, Roanoke 7, Virginia.

RAISE Giant Chinchilla rabbits. Tremendous profits from gorgeous fur, delicious meat. Ideal business. Willow Farm, R 16A, Sellersville, Pa.

RECAST old batteries into new. Latest achievements. Battery Laboratories, Minneapolis.

BIG Pay jobs in welding. Complete welding lessons and reference books, 516 pages, 41 lessons, $2.00 copy. Money-back guarantee. Hobartweld, Box P-1065, Troy, Ohio.

FLASH. New Novelty Large Profits, Dime, Hurry. Martin, P. S., 57 Hart, New Britain, Connecticut.

MECHANICALLY Inclined Men—Own and operate general Appliance Repair Shop. Complete, illustrated course shows you how. Welding, Refrigeration, Motor repair. How to get business, etc., all phases covered. Free literature. Christy Supply, Dept. 771, 2835 N. Central Ave., Chicago.

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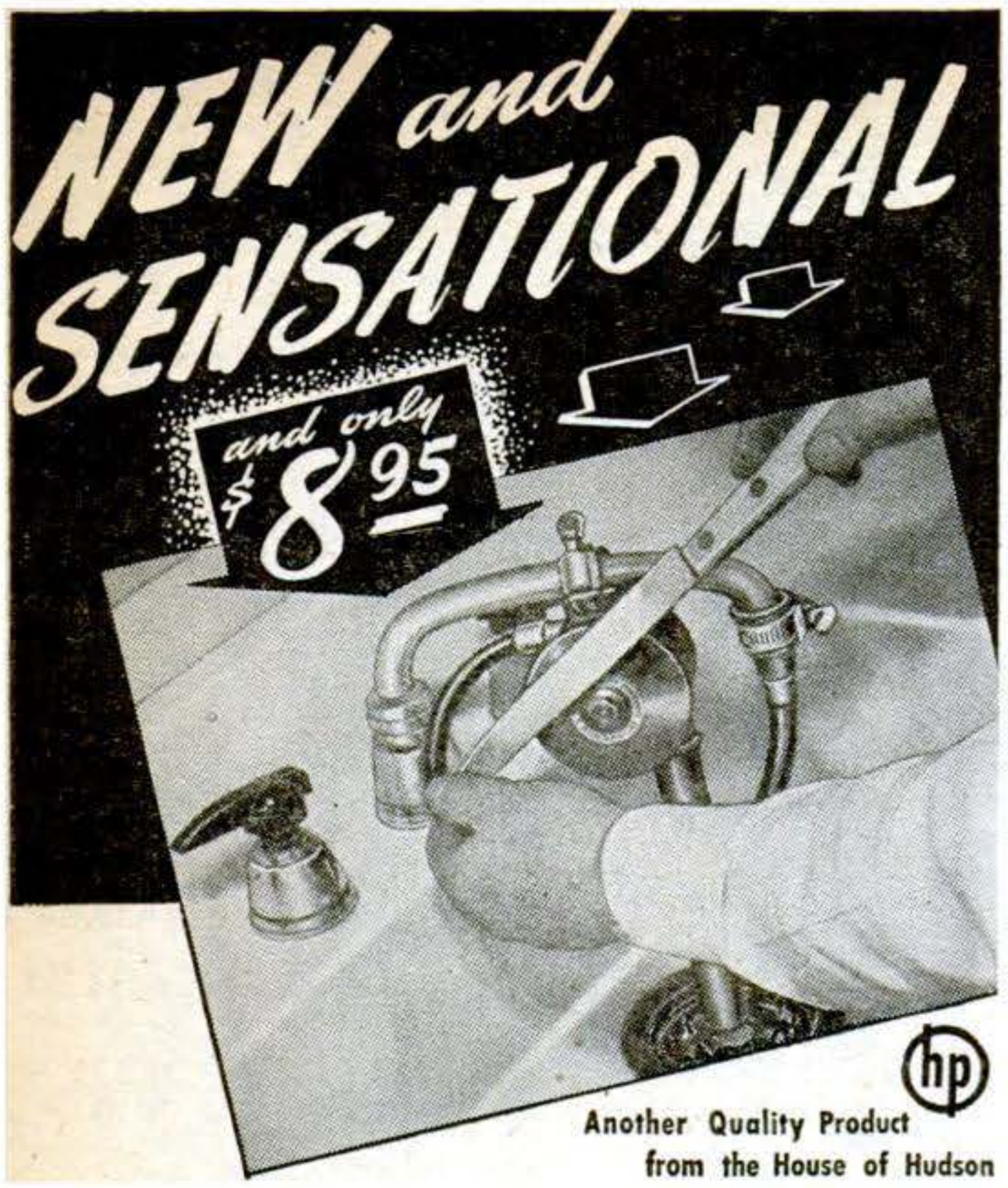

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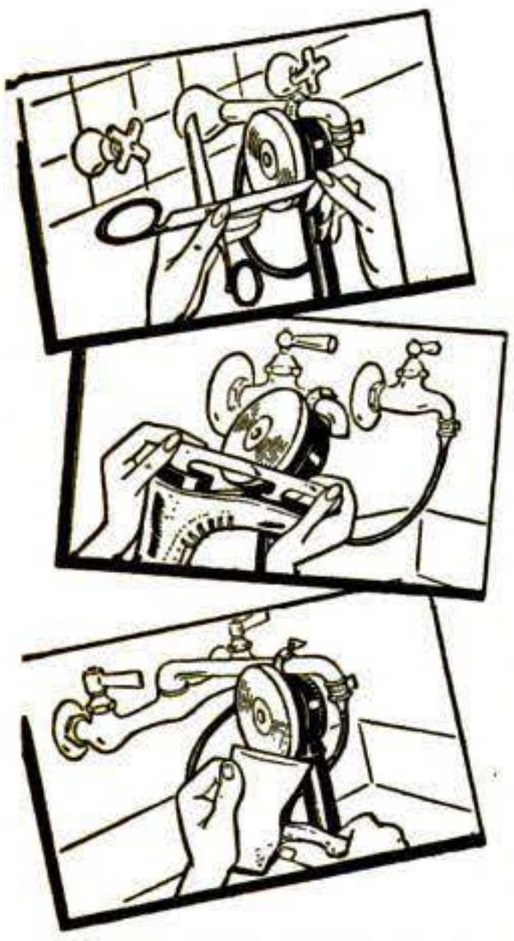

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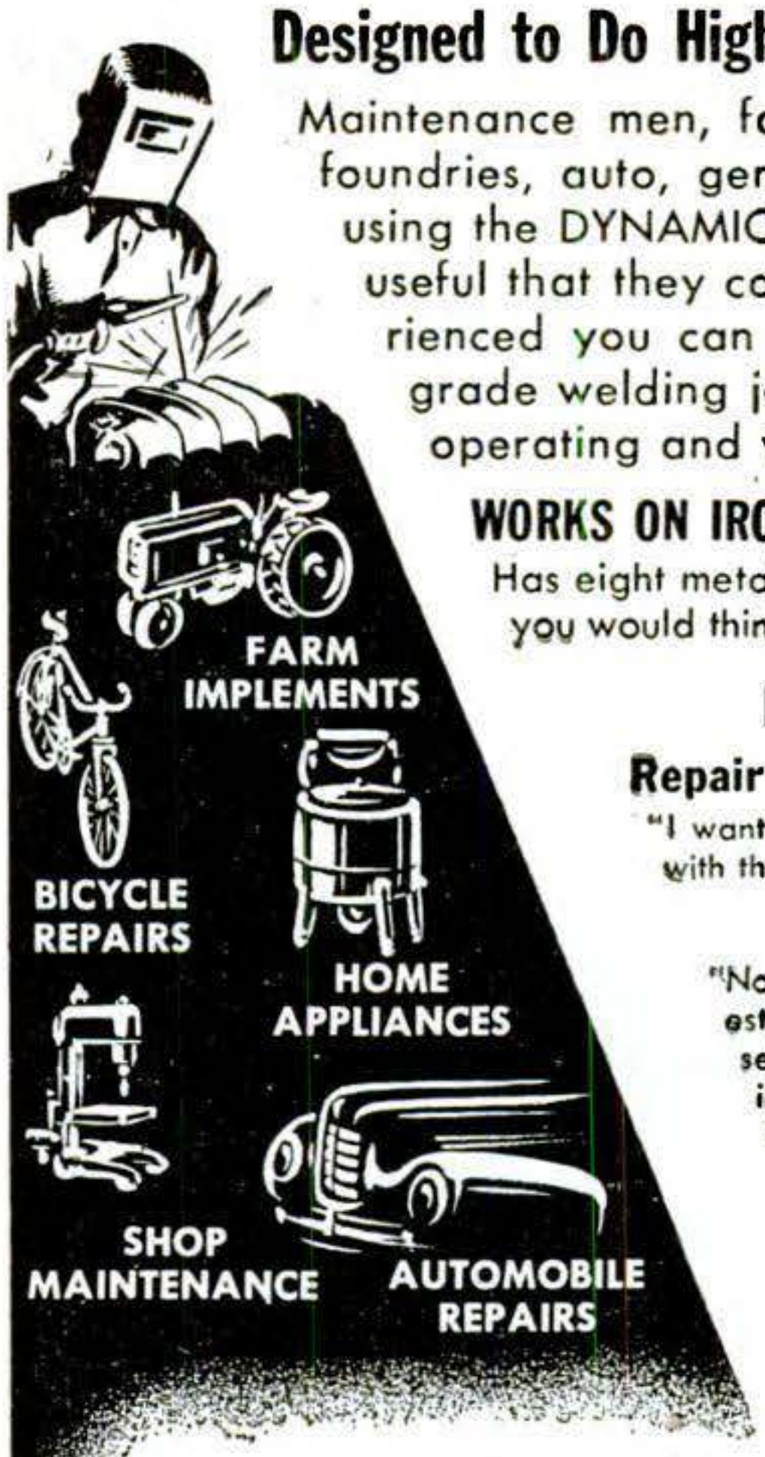

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TO: Reader
FROM: Editor

Annual Report —to YOU!

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FRANCIS

IT IS JUST a year since this page was started. I told you, then: "My job as editor is to act as *your agent* with all the writers, researchers, photographers, and artists it takes to give you what you want in this magazine about science and the citizen."

All of those whose names are flags at the masthead on the contents page will tell you that I consider the editor to be, actually, the "*head reader.*" And sometimes they don't like my working in your capacity.

As head reader I am perfectly willing to stick my neck way out and say, "I like this; I don't like that." As head reader—your pre-reader—I have felt perfectly free to ask for a lot of things which are not so easy to do.

Among the first requests, in this past year, was the elimination of what are called "runovers"—those "continued on page so-and-so's" which make you choose between continuing the story and continuing the magazine. And which also, I might add professionally, serve as a handy can for literary garbage.

That sounds easy, doesn't it? But it meant work planning a story in terms of total words and pictures—and, most important, its worth to you. It also meant the production of fresh, additional, and interesting material for those back columns.

Another thing I asked for, my own eyes being none too good, was bigger type which would be easier to read. This on the basis that most of you, my associate readers, were either on the poor-eye side like me, or had fresh, young eyes which should be saved. And don't think this was easy—it meant cutting stories an *extra* nine percent!

Probably you haven't been conscious of such obvious things as page numbers on every page—but many a magazine which "bleeds" pictures clear out to the cut edge drops them out. This meant planning ahead the position of any article with big bleed pictures.

I hope you like the new "tags" for quick identification of the departments, and the expanded table of contents.

Also, I hope you like the "cover stories" which don't leave you in midair with just a sensational picture, but try to give you a well-rounded view of an important and interesting subject. My mail and your answers to our monthly questionnaire seem to indicate your appetite for steak on the plate as well as on the menu.

Finally, I would like to tell you a little of what you should not be conscious of at all, but which I, as head reader, think is the most important thing in PSM. That is *readability.*

This word *readability* includes, in my language, the ease with which you can *look over and into* a magazine. Pictures and headlines as easy to see as the hands on your watch. Layouts which neither dazzle nor dull the eye. Text *written for reading.*

These last are the invisible improvements your staff is constantly trying to make.

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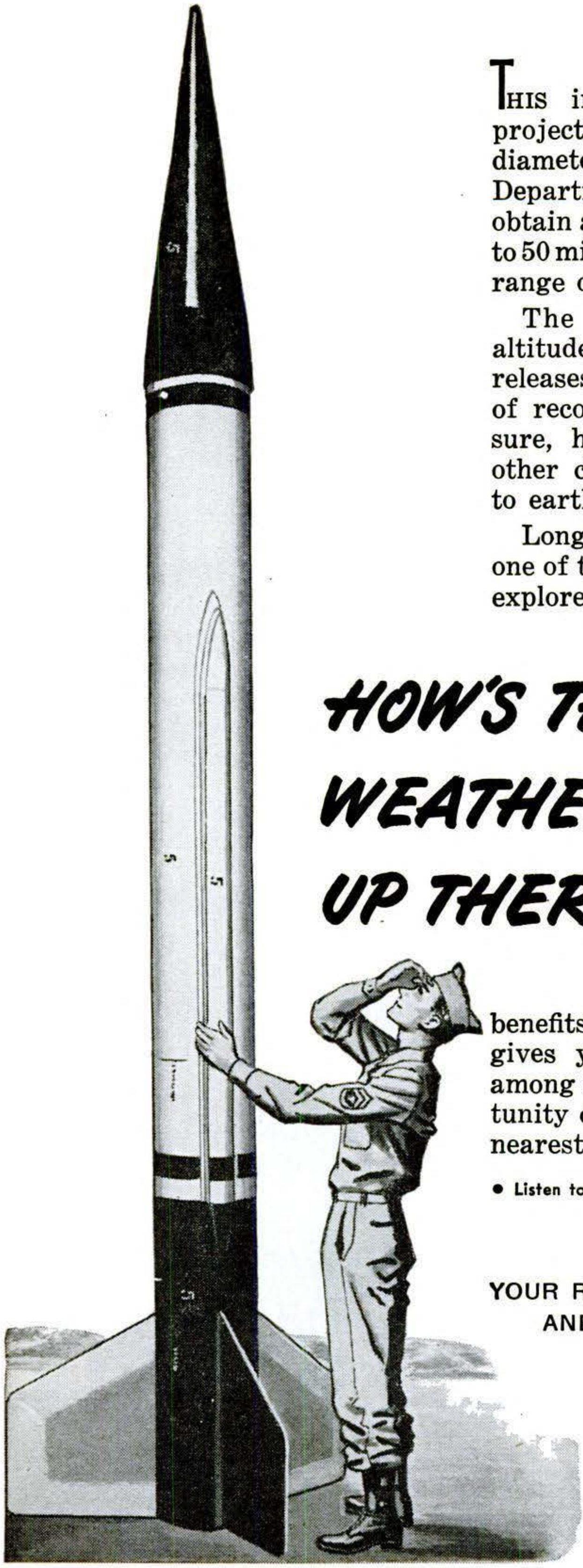

THIS ingenious device is a rocket-driven projectile about 16 feet long and a foot in diameter. Developed by the Army Ordnance Department, it is used by the Signal Corps to obtain accurate data on weather conditions 30 to 50 miles up in the ionosphere—far beyond the range of aircraft observation or radiosonde.

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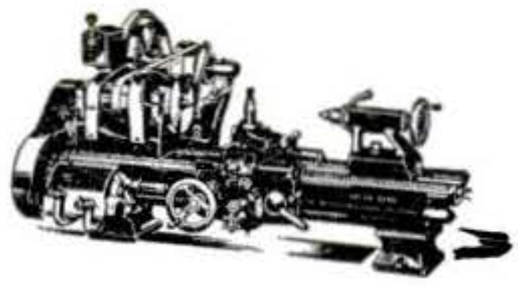

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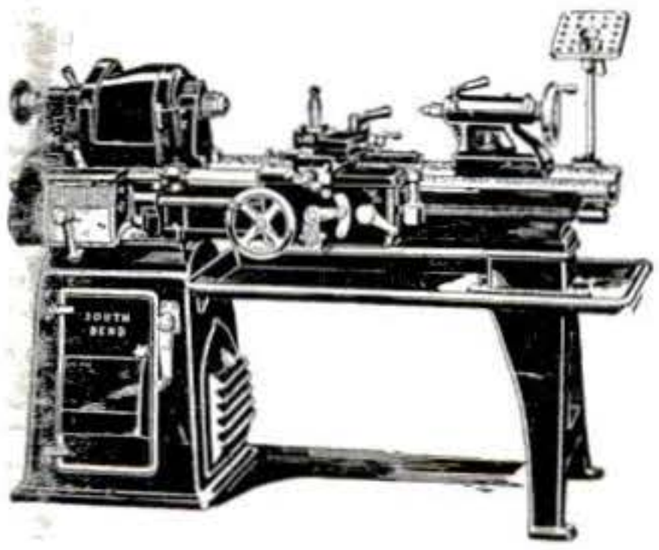
10" Bench Lathe

10" Engine Lathe



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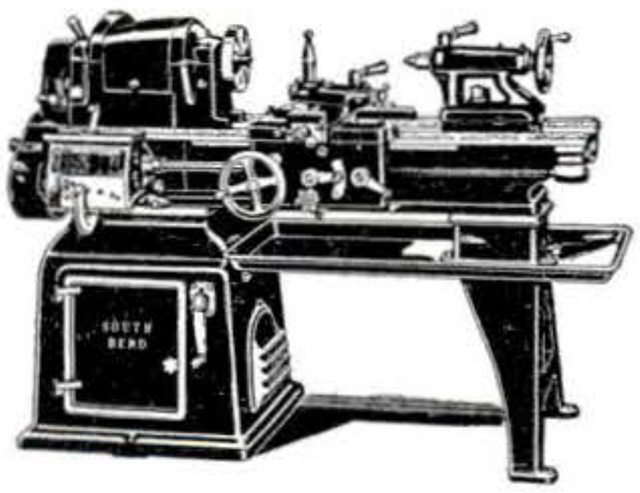

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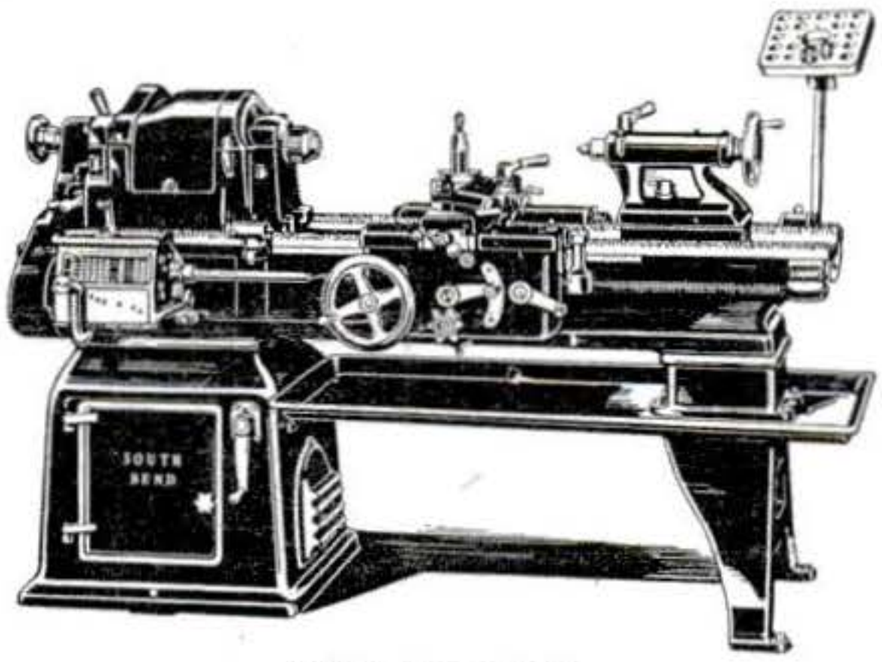

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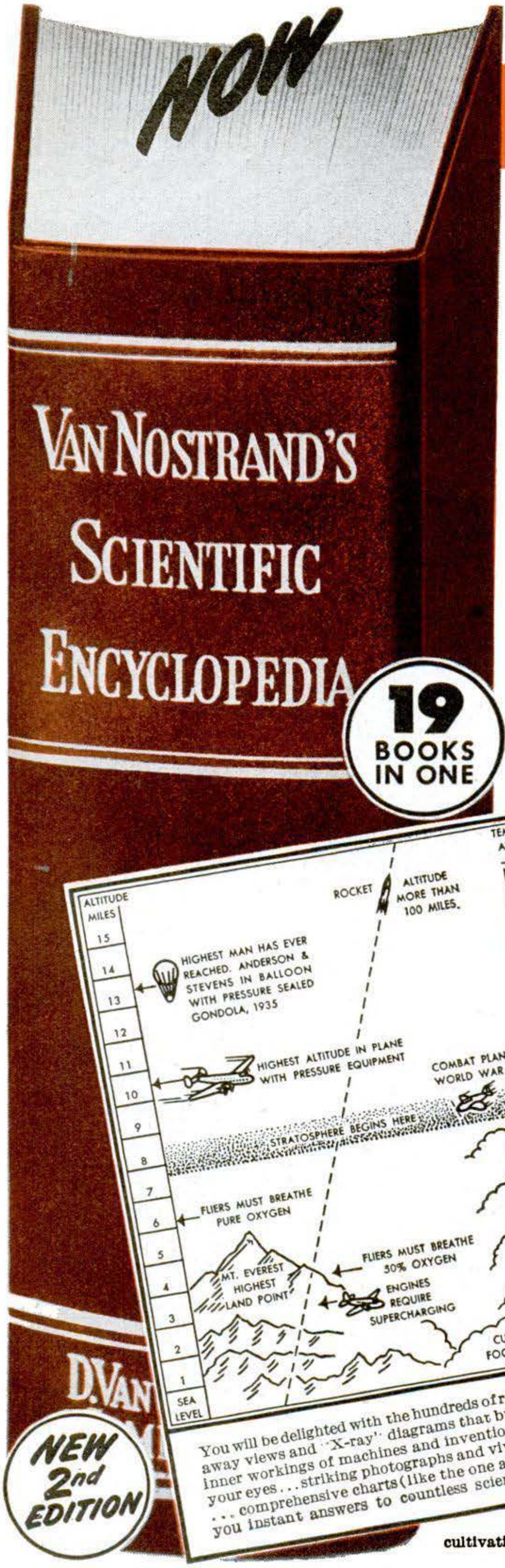
p. 66



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FEBRUARY 1947

SCIENCE NEWS

Television on the Job..... 66
Tube Traps Germs..... 80
Smaller Motor Is Huskier..... 93
Electronic Color Television Is Here.....100
Vibrations Expose Flaws.....134
Rockets Soup Up British Bike.....135

SCIENCE AT WORK

Picture of the Month..... 65
Camera Shoots an Engine's Knock..... 80
Vibrator Tests Tubes..... 81
Mud Slinger 88
Stitching Steel Into Streamliners.....121
Magnet Concentrates Pull.....128

PSM FEATURES

Movie Shows A-Bomb's Birth..... 82
You're Going to Freeze..... 89
How Phonograph Records Are Made..... 94
Four-Row Corn Picker..... 98
Taking a Grasshopper's Temperature..... 99
Whizzing on Fizz.....102
Thinking in Glass.....104
Radar Works on an Ore Boat.....111
Storage Tanks for Tanks.....112
Road-and-Railer 114
Floodlight Truck for Fires.....116
Spotlight Shines Half a Mile.....128
Latest Rural Head Lines.....129
Edison's Magnificent Fumble.....130
Danish Furniture Knocks Down.....169
Table Magic 197
Colloids . . . Liquids or Solids?.....198

AVIATION

Jets Go to Sea..... 74
Air Lines Warm Up Arctic Short Cut..... 76
Plane Tire Made with Wire..... 79
What's New in Aviation..... 84
Flying Flapjack (Pin-up)..... 97
Three Routes to Supersonic Flight.....109
Twisting a Giant's Tail.....117

AUTOMOBILES

Auto Sprouts a Wing..... 73
Two-Minute Car Washer..... 79
Truck Is a "Trike"..... 87
Gus Slows a Speeder.....140
Windshield-Wiper Booster Tank.....143
Give Your Battery a Break.....144

INVENTIONS

Robot Digs British Coal..... 73
Rolling Ladder 98
I'd Like to See Them Make.....110
New Ideas from the Inventors.....118

PHOTOGRAPHY

Camera Dolly Aids Closeups..... 93
Plywood Camera for Photo Copying.....182

(CONTINUED ON PAGE 4)

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- ☐ Architectural Drafting
- ☐ Architecture
- ☐ Building Estimating
- ☐ Civil Engineering ☐ Coal Mining
- ☐ Contracting and Building
- ☐ Highway Engineering
- ☐ Lumber Dealer
- ☐ Reading Structural Blueprints
- ☐ Sanitary Engineering
- ☐ Structural Drafting
- ☐ Structural Engineering
- ☐ Surveying and Mapping

Communications Courses
- ☐ Electronics
- ☐ Practical Telephony
- ☐ Radio, General
- ☐ Radio Operating
- ☐ Radio Servicing
- ☐ Telegraph Engineering

Electrical Courses
- ☐ Electrical Drafting
- ☐ Electrical Engineering
- ☐ Electric Light and Power
- ☐ Lighting Technician
- ☐ Practical Electrician
- ☐ Power House Electric
- ☐ Ship Electrician

Internal Combustion Engines Courses
- ☐ Auto Technician ☐ Aviation
- ☐ Diesel-Electric
- ☐ Diesel Engines ☐ Gas Engines

Mechanical Courses
- ☐ Aeronautical Engineering
- ☐ Aircraft Drafting
- ☐ Flight Engineer
- ☐ Forging
- ☐ Foundry Work
- ☐ Heat Treatment of Metals
- ☐ Industrial Engineering
- ☐ Industrial Metallurgy
- ☐ Machine Shop
- ☐ Machine Shop Inspection
- ☐ Mechanical Drafting
- ☐ Mechanical Engineering
- ☐ Mold-Loft Work
- ☐ Patternmaking—Wood, Metal
- ☐ Reading Shop Blueprints
- ☐ Sheet-Metal Drafting
- ☐ Sheet-Metal Worker
- ☐ Ship Drafting ☐ Ship Fitting
- ☐ Tool Designing ☐ Toolmaking
- ☐ Welding—Gas and Electric

Railroad Courses
- ☐ Air Brake ☐ Car Inspector
- ☐ Diesel Locomotive
- ☐ Locomotive Engineer
- ☐ Locomotive Fireman
- ☐ Railroad Section Foreman

Steam Engineering Courses
- ☐ Boilermaking
- ☐ Combustion Engineering
- ☐ Engine Running
- ☐ Marine Engineering
- ☐ Steam Electric ☐ Steam Engines

Textile Courses
- ☐ Cotton Manufacturing
- ☐ Rayon Weav'g ☐ Textile Desig'ng
- ☐ Woolen Manufacturing

*Name*_____ *Age*_____ *Home Address*_____

*City*_____ *State*_____ *Present Position*_____

*Working Hours*_____ *A.M. to*_____ *P.M.* **Length of Service in World War II** _____

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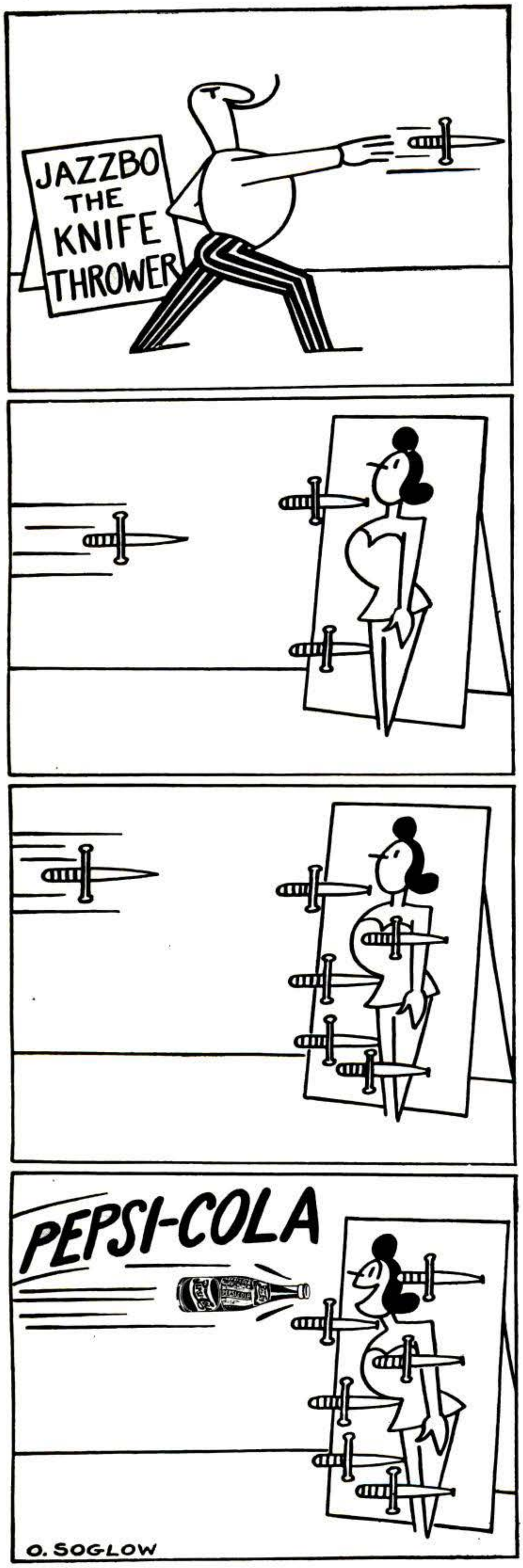

MECHANICS & SHOPCRAFT

Anchoring Chair-Leg Tenons....152
Wood Collets Hold Dowel Mandrels....159
Cutting Head Made from Valve....168
Low-Cost Tool-Post Grinder....172
Wrench for Locking Lathe Carriage....173
Two Adjustable Tailstock Centers....174
Lathe Center Tester....178
Spring Overcomes Lag in Vise....203
Emergency Belt for Power Tools....206

HOME MECHANICS & HANDICRAFT

Farming in a Small Way....115
Craftwork Projects of the Month....120
Aluminum-and-Plastic Tray....148
Metal-Ornamented Jewel Box....151
Puppet Dances with the Wind....153
Whittled Frog Paperweight....158
Wheelbarrow from Victrola Top....159
Moldings from Curtain Rods....161
Preparing Walls for Plaster....164
Bottle Caps Hold Stucco....168
Smoking Stand and Magazine Rack....170
Repairing a Spade....186
Errors in Building a Roof....202
Cubicle for Allergy Sufferers....203
Sealing a Foundation....203
Repairing Old Doorknobs....204
Pin Repairs Lighter Wick....206
Wagon-Wheel Mailbox....207

RADIO & ELECTRICITY

Radio's "Darkroom"....81
Radio Prints Home Paper....93
Dry-Land Navigation Training....113
Electricity Computes Floods....128
Electrons Test Surfaces....134
Soldering-Iron Thermostat....179
News in Electronics....188
Infrared Lamp Flattens Records....189
Four Modern Crystal Sets....190
Detachable Ground Connection....196

DEPARTMENTS

Voice of Science....7
Letters....16
Modern Living....136
Auto Ideas....138
Auto Hints....146
New Tools....150
What's Your Ingenuity Quotient?....157
Keeping the Home Shipshape....162
Photo Ideas....180
Home Experiments....194
For Easier Farming....208
Editorial Memo....286

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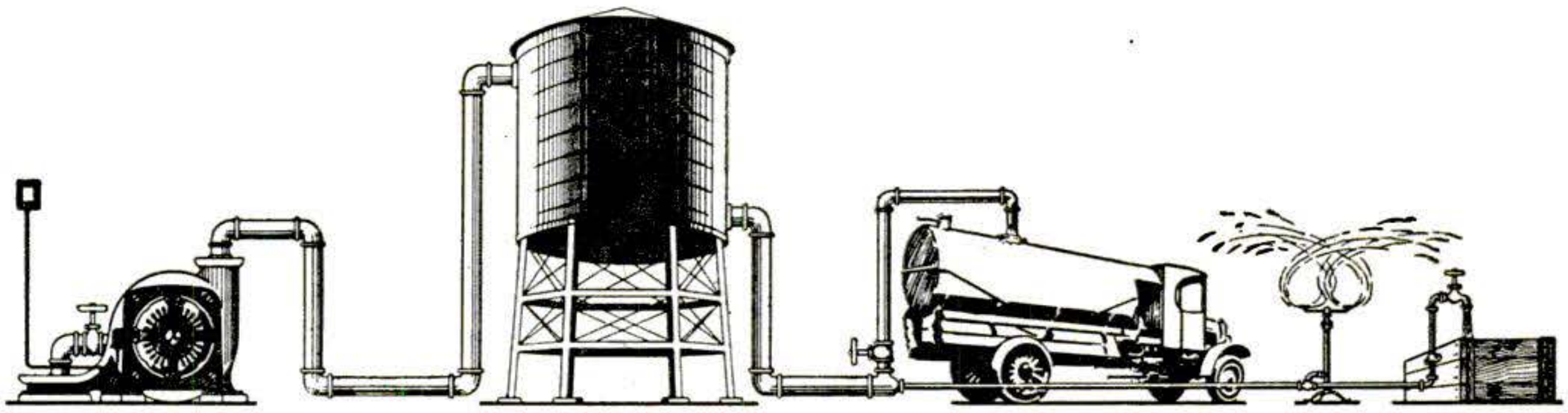
WHY MUST A BATTERY BE RECHARGED?

"Why the Reservoir Runs Dry"

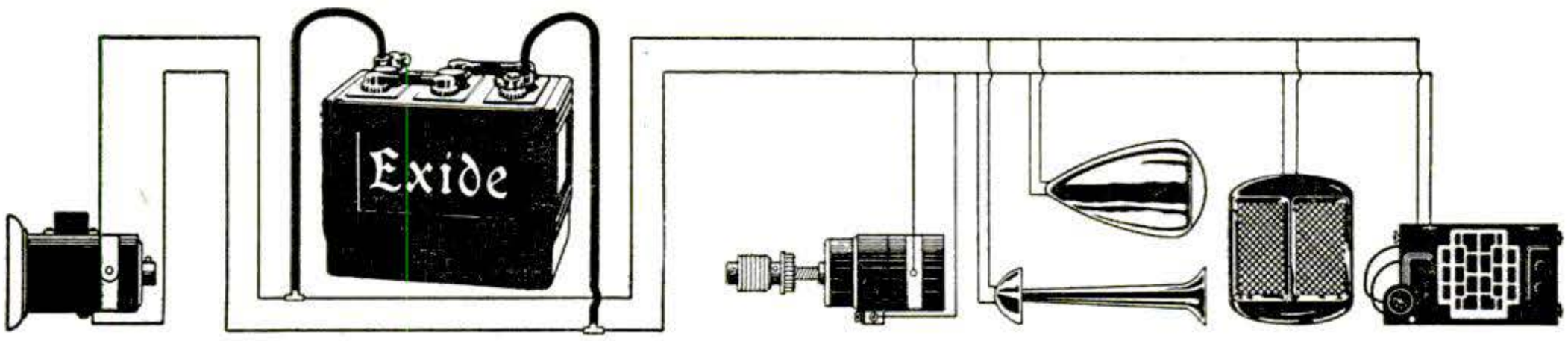


Water Pump
(Operated Intermittently)

WATER RESERVOIR
If you take out more than you put in, the tank will run dry.

Water Outlets

"Why the Battery Runs Down"



Car Generator
(Operated Intermittently)

ELECTRICAL RESERVOIR
If you take out more than you put in, the battery will run down.

Starter

Lights
Horn

Heater

Radio

An automobile battery stores energy, which is constantly being drained by starting, lighting, and supplying current for other purposes. This energy must be restored; otherwise, like water in a tank, it eventually is exhausted.

But, unlike refilling a tank, the battery system on an automobile is automatic. When a car is in average use, the battery is kept at or near full charge; if the car is driven less than the normal minimum, charging is insufficient and the battery "runs down."

See that your battery is kept properly charged.

Check every two weeks to see if water is needed. If water is required more often, the amount of charging is too great; if too little water is required and the hydrometer reading shows below 1.225, the battery is charging too little. Any Exide Dealer will be glad to show you how to get the best service from your battery.

Would you like to know more about batteries? The complete story is told in a booklet, "THE STORAGE BATTERY, Its Fundamentals, Use and Maintenance." Mail a postal card today for a FREE copy.

"WHEN IT'S AN EXIDE YOU START"

Exide
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

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EVER hear of the Optiphone? It's an ingenious device for telephone communication over a light-beam. The U. S. Army Signal Corps developed and improved it for military use.

With a daytime range of seven miles, the Optiphone has certain advantages over radio. Its path is so narrow that messages are almost wholly safe from interception. At night the beam is made invisible by infra-red filters.

The device has definite possibilities for civilian use, such as short-range communication on construction jobs, and temporary replacement of broken telephone lines during floods or other catastrophes.

New discoveries and inventions are constantly being developed in the peacetime Regular Army. Its research covers almost the whole range of modern science. For intelligent young men, eager to share in advances that will benefit all humanity, there's no finer place to get experience than in the Army. Radar and Electronics, Nuclear Energy, Jet Propulsion and Supersonic Flight are just a few of the fields which offer promising careers to qualified young men.

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U. S. Army
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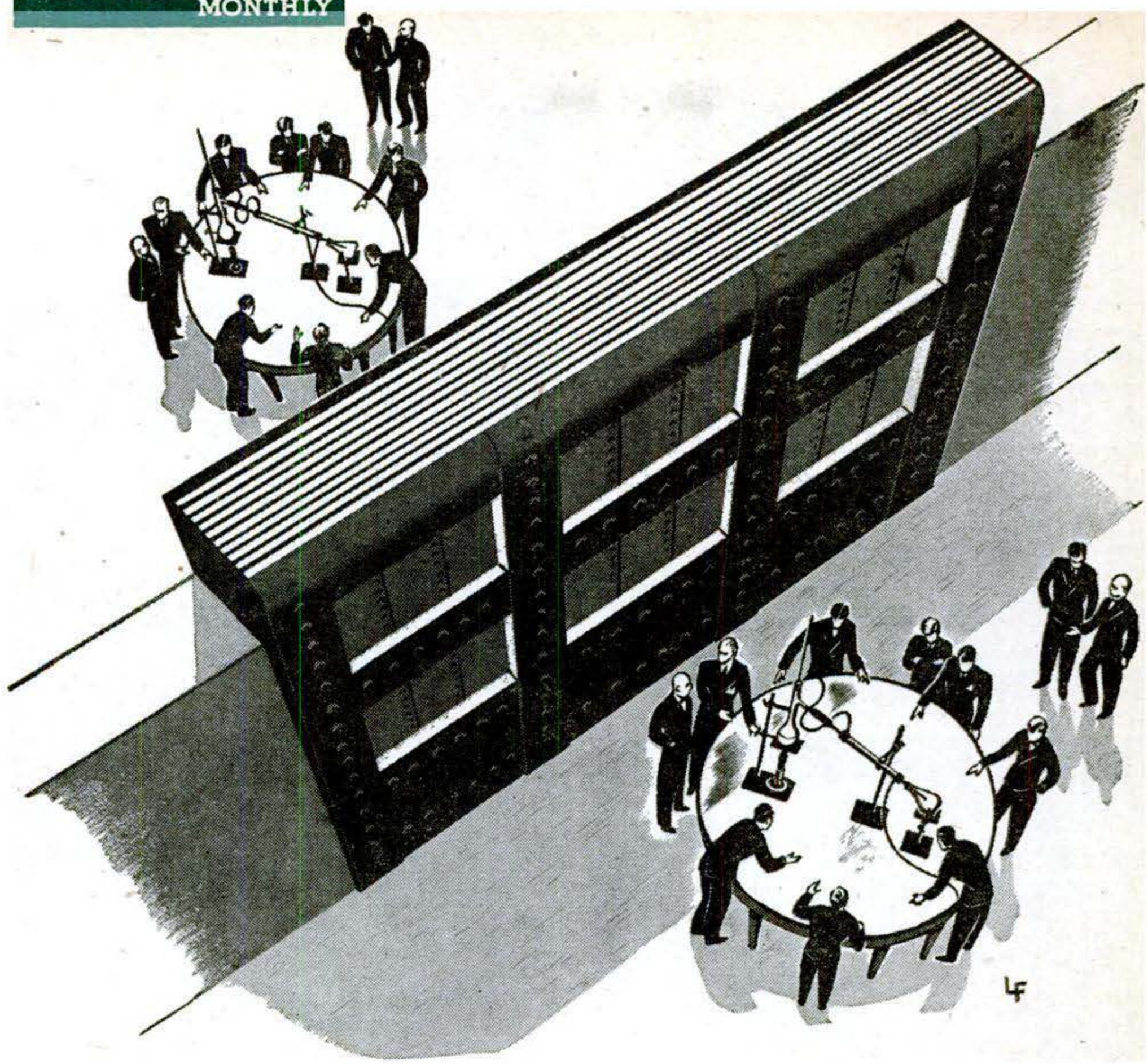

Must Science Have Iron Curtains?

"COMPARTMENTALIZATION" is just a twenty-letter dirty word to true scientists. It stands for the separate, and usually secret, pursuit of the same knowledge by different groups. During the war it became an iron curtain which cut off the glow of ideas as effectively as any other boiler-plate drapery.

Take what went on in two tight-guarded buildings in Cambridge, Massachusetts. In the Radiation Laboratories at the Institute of Technology, one chain gang of scientists worked around the clock on radar. Up river, in the Radio Research Laboratory at Harvard, another chain gang worried away at *counter*-radar. Both did magnificent work. But, working apart, they must have wasted many a day and dollar doing some of the same things.

Many a sincere scientist can confess today that there were too many teams solving the same problems; that too many related problems had to be solved separately. It was a joke at the counter-radar labs that a foreign spy had a better chance of getting in than a brother scientist from the radar labs. It was a costly joke because time is the costliest ingredient.

Research is slowed by secrecy. True security lies in speed. Speed of search and application made possible not only by heavy outlays of men and money, but by the quick and constant flow of information.

Perry Gilkeson

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MURRAY KORMAN

Show you how to crash the ranks of "big shot" photography with this sensational new course that fully reveals all the master secrets of glamour photography. It's sure fire! It's fool proof! And it's easy!

Nancy Valentine

Pat Farrell

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- How to pose your subjects...how to arrange their shoulders, legs, head ...what pose is best for each subject.
- How to glamorize your composition and best backgrounds for each.
- How to select best camera angles.

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SATISFACTION GUARANTEED! Murray Korman backs this course with his outstanding reputation. You just have to succeed — the Murray Korman way!

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Haven't you always wished you, too, could take glamour portraits instead of ordinary snapshots? "The Art of Glamour Photography" is your magic key to taking pictures as lovely as the best professionals take!

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3—How to take "over the shoulder" glamour portraits.
4—How to take glamorous full standing pin-ups.
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Think of it. 5 complete courses for $10.00. That figures out to only $2.00 each. What a bargain! And from no other source can you obtain the sensational kind of "inside secrets" you get from the great master himself!

Act now. Send no money!

Don't hem and haw about this. Fill in and mail coupon below. Complete course will be sent you by return mail. You simply pay postman $10.00 plus few cents postage. Or send $10.00 bill, check or money order and Murray Korman pays postage.

This is the "Break you've been waiting for." So mail coupon today and take advantage of Murray Korman's sensational offer of 12 glamour photos absolutely FREE with complete course if you act quickly.

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Send me by return mail your sensational new complete course, "The Art of Glamour Photography," at the special price of $10.00. And in addition, absolutely free, you will also send me 12 glamour portraits of the world's most beautiful women.

Please send complete course plus 12 glamour portraits C.O.D. I will pay postman $10.00 plus few cents postage.

I want to save postage. Send complete course plus 12 glamour portraits pre-paid! Enclosed is $10.00.

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Why not be somebody in the business world—why be satisfied to go through life in a small job at small pay when the way to success is clearly marked. The years are going by very fast—and it's high time you did something concrete about your future.

The coupon below will bring you complete information about the field of your choice. SEND IT TODAY. Don't delay—it can be the turning point in your career to a better job and more money.

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TELEVISION

ELECTRONICS

FREQUENCY MODULATION

SAMPLE LESSON FREE

SEE OPPOSITE PAGE

Do you want a good-pay job in Radio—or your own money-making Radio Shop? Mail Coupon for a FREE Sample Lesson and my FREE 64-page book, "How to be a Success in RADIO—Television, Electronics." See how N.R.I. gives you practical Radio experience at home — building, testing, repairing Radios with BIG KITS OF PARTS I send!

Many Beginners Soon Make Good Extra Money in Spare Time While Learning

The day you enroll I start sending EXTRA MONEY JOB SHEETS. You LEARN Radio principles from my easy-to-grasp, illustrated lessons—PRACTICE what you learn with parts I send—USE your knowledge to make EXTRA money fixing neighbors' Radios in spare time while still learning! From here it's a short step to your own *full-time* Radio Shop or a good Radio job!

Future for Trained Men is Bright in Radio, Television, Electronics

It's probably easier to get started in Radio now than ever before because the Radio Repair business is booming. Trained Radio Technicians also find profitable opportunities in Police, Aviation, Marine Radio, Broadcasting, Radio Manufacturing, Public Address work. Think of even *greater* opportunities as Television and Electronics become available to the public!

Find Out What N. R. I. Can Do For You

Mail Coupon for Sample Lesson and my 64-page book. Read the details about my Course. Read letters from men I trained, telling what they are doing, earning. See how quickly, easily you can get started. No obligation! Just MAIL COUPON NOW in an envelope or paste it on a penny postal. J. E. SMITH, President, Dept. 7BP3, National Radio Institute, *Pioneer Home Study Radio School,* Washington 9, D. C.

Our 33rd Year of Training Men for Success in Radio

A TESTED WAY

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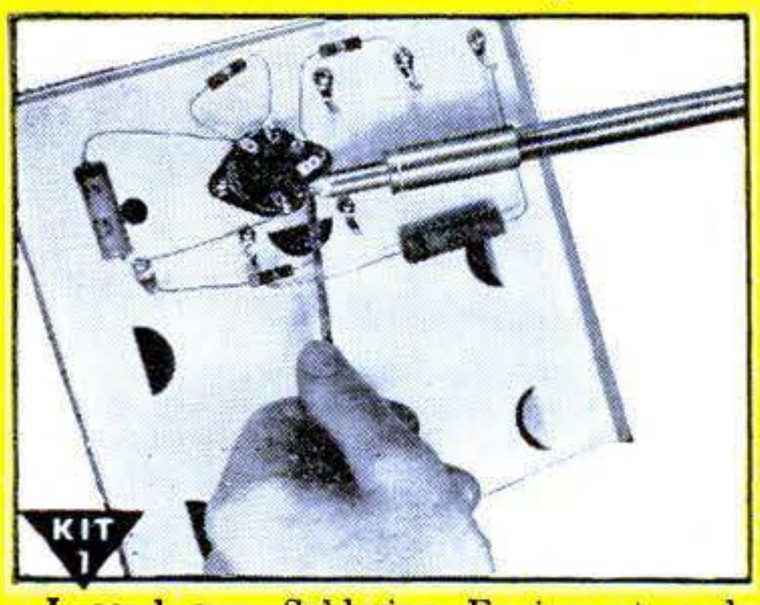
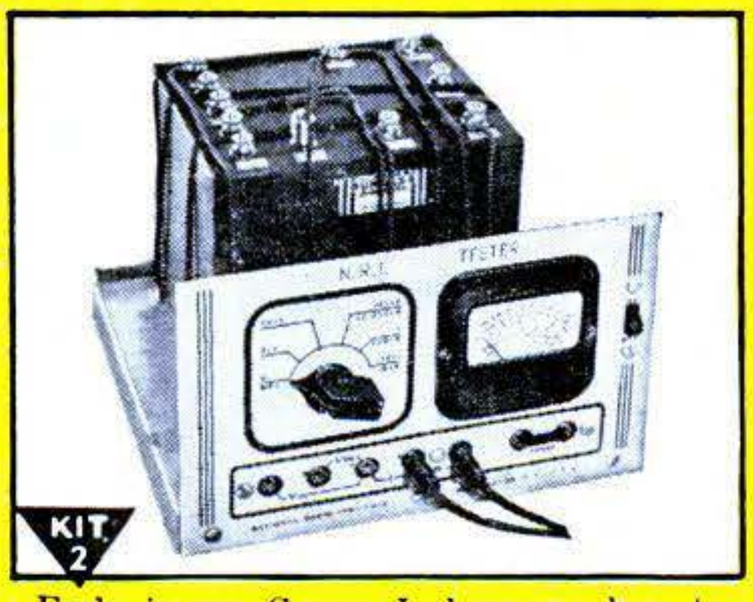
OWN BOSS

LEARN RADIO BY PRACTICING IN SPARE TIME

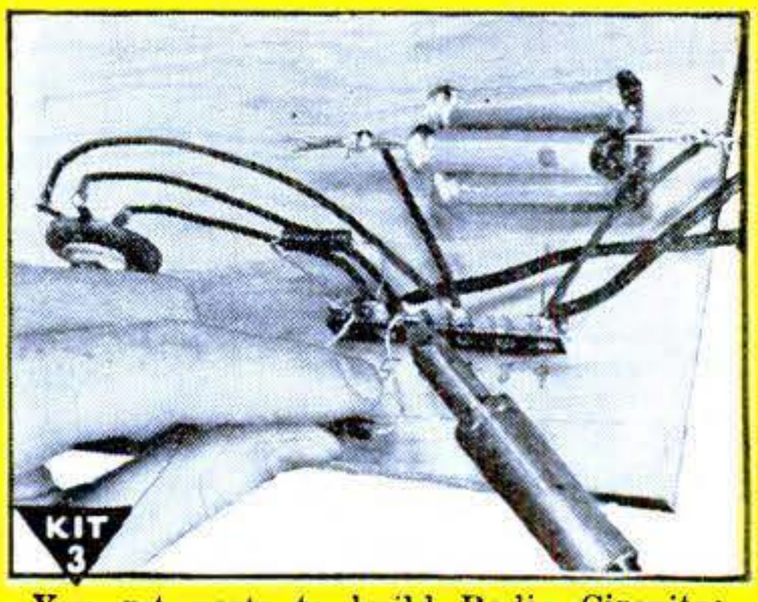
with Big Kits of Radio Parts I Send You!



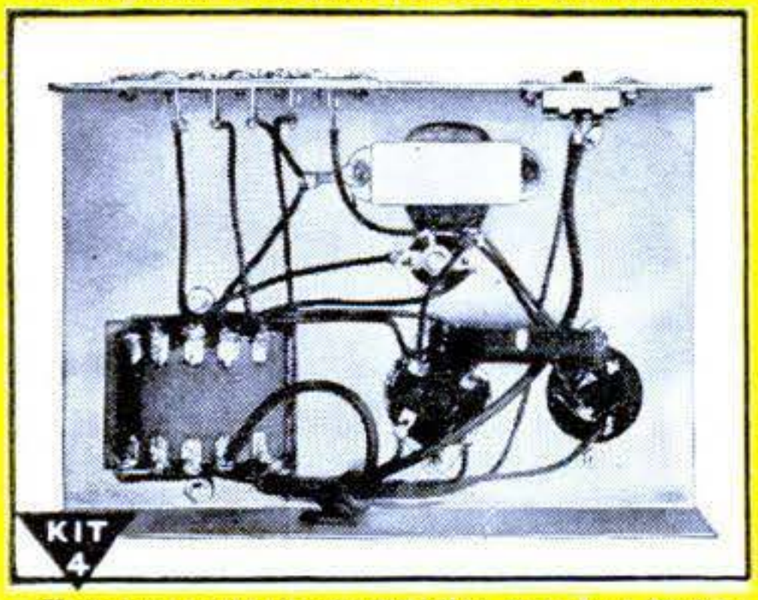
I send you Soldering Equipment and Radio Parts; show you how to do Radio soldering; how to mount and connect Radio parts; give you practical experience.



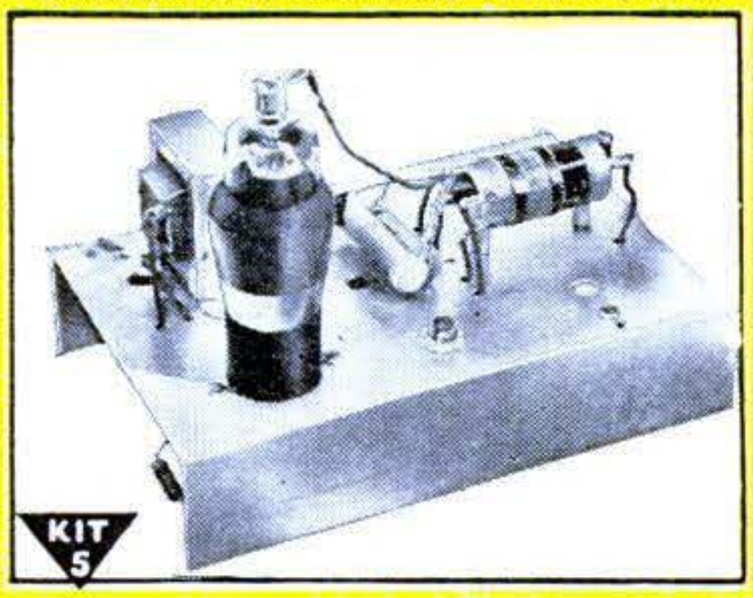
Early in my Course I show you how to build this N.R.I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.



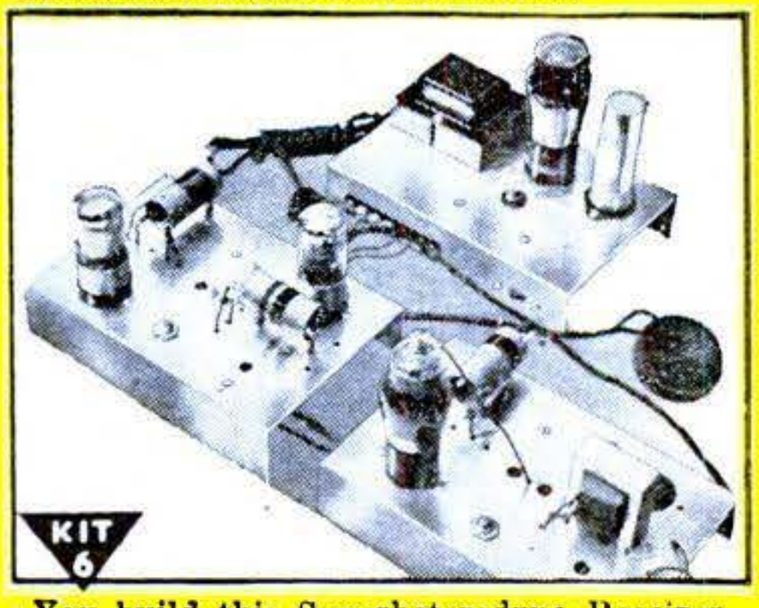
You get parts to build Radio Circuits; then test them; see how they work; learn how to design special circuits; how to locate and repair circuit defects.



You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



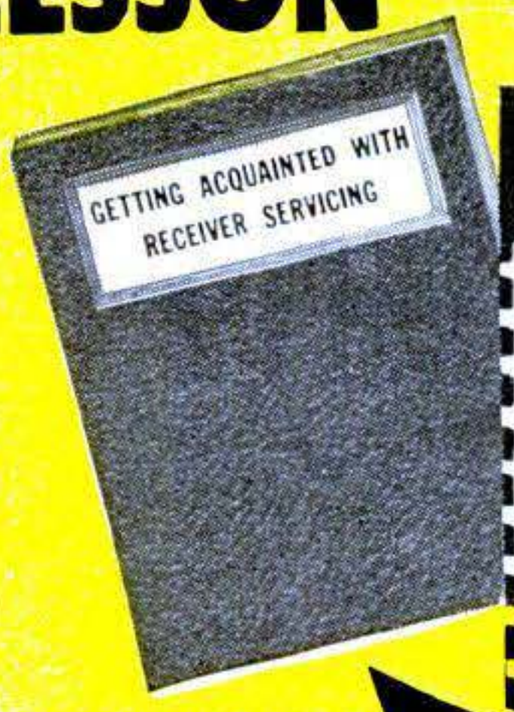
Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.



You build this Superheterodyne Receiver which brings in local and distant stations—and gives you more experience to help you win success in Radio.

SAMPLE LESSON FREE

I will send you a FREE Lesson, "Getting Acquainted with Receiver Servicing," to show you how practical it is to train for Radio at home in spare time. It's a valuable lesson. Study it—keep it—use it—without obligation! Tells how Superheterodyne Circuits work, gives hints on Receiver Servicing, Locating Defects, Repair of Loudspeaker, I.F. Transformer, Gang Tuning, Condenser, etc. Thirty-one illustrations.



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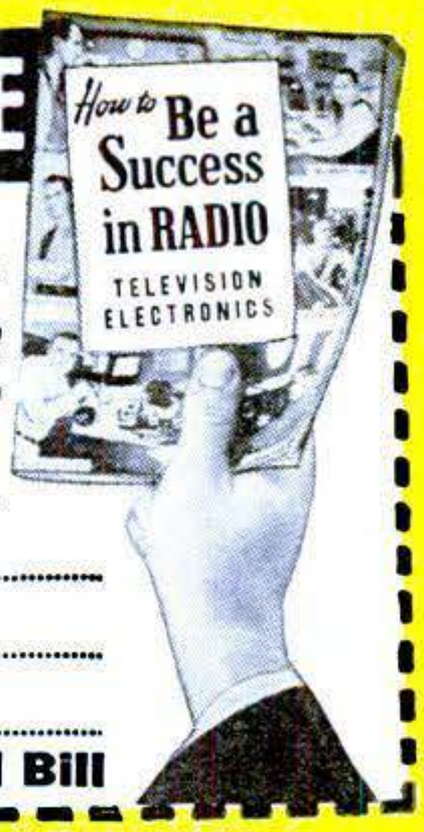

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Address.....

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HAVE YOU READ volumes on the power of thought? Perhaps you have listened to lengthy theoretical addresses on the forces of mind. You may have wondered if these same writers and lecturers on mind power know how to use it. How many mountains of personal obstacles—everyday trials and tribulations—have *they* moved? What are these subtle principles whereby man can skillfully remove the barriers that impede his progress? How can *you* displace the obstructions and hindrances to *your* goal...the mountains in *your* life? Can practical information about inner power be reduced to mere words...words for public dissemination? Or, is there a secret method especially and uniquely preserved for the worthy seeker...practicable only under ideal circumstances? If so, who has the secret method? Where can it be found?

Investigate the Rosicrucians (NOT a religion), the oldest *practical* pholosophical fraternity on earth. See if they cannot show you a method for attainment such as you may not have dreamed. Thousands of men and women today are enjoying mental mastery...realization of ideals...the attainment of their objectives. They *know* the secret methods for converting mountains of personal problems into green valleys of achievement.

ACCEPT THIS OFFER

A FREE book, *The Mastery of Life,* is yours for the asking. It explains how easily you may enter upon the path of attainment. Fill in and send coupon *today!*

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Please send me the book, *The Mastery of Life,* which explains how I may learn to use my faculties and powers of mind.

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What's My Job?—I Manufacture Weaklings into MEN!

Charles Atlas

Actual photograph of the man who holds the title "The World's Most Perfectly Developed Man."

GIVE ME a skinny, pepless, second-rate body —and I'll cram it so full of handsome, bulging new muscle that your friends will grow bug-eyed! . . . I'll wake up that sleeping energy of yours and make it hum like a high-powered motor! Man, you'll **feel** and **look** different! You'll begin to **LIVE!**

Let Me Make YOU a NEW MAN —IN JUST 15 MINUTES A DAY!

YOU wouldn't believe it, but I myself used to be a 97-lb. weakling. Fellows called me "Skinny." Girls snickered and made fun of me behind my back. I was a flop. THEN I discovered my marvelous new muscle-building system—"*Dynamic Tension.*" And it turned me into such a **complete** specimen of MANHOOD that today I hold the title "THE WORLD'S MOST PERFECTLY DEVELOPED MAN."

That's how I traded in my "bag of bones" for a barrel of muscle! And I felt so much better, so much **on top of the world** in my big, new, husky body, that I decided to devote my whole life to helping **other** fellows change themselves into "perfectly developed men."

What Is *"Dynamic Tension"*? How Does It Work?

When you look in the mirror and see a healthy, husky, strapping fellow smiling back at you—then you'll be astounded at how **short** a time it takes *"Dynamic Tension"* to GET RESULTS!

"Dynamic Tension" is the easy, NATURAL method you can practice in the privacy of your own room—JUST 15 MINUTES EACH DAY—while your scrawny shoulder muscles begin to swell, ripple . . . those spindly arms and legs of yours bulge . . . and your whole body starts to feel "alive," full of zip and go!

One Postage Stamp May Change Your Whole Life!

As I've pictured up above, I'm steadily building broad-shouldered, dynamic MEN—day by day—the country over.

2,000,000 fellows, young and old, have already gambled a postage stamp to ask for my FREE book. They wanted to read and see for themselves how I'm building up scrawny bodies, and how I'm paring down fat, flabby ones—how I'm turning them into breath-taking human dynamos of pure MANPOWER.

Take just a few seconds NOW to fill in and mail the coupon at right, and you will receive at once my FREE book—"Everlasting Health and Strength" that PROVES with actual snap-shots what *"Dynamic Tension"* has done for others—what it can do for YOU! Address: CHARLES ATLAS, Dept. 12, 115 East 23rd Street, New York 10, N. Y.

FREE

Mail the coupon below **right now** for my FREE illustrated book, "Everlasting Health and Strength." Tells all about *"Dynamic Tension"* methods. Crammed with pictures, facts! Address me personally: CHARLES ATLAS, Dept. 12, 115 E. 23rd St., New York 10, N. Y.

MAIL COUPON FOR FREE BOOK

CHARLES ATLAS, Dept. 12
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I want the proof that your system of *"Dynamic Tension"* will help make a New Man of me—give me a healthy, husky body and big muscular development. Send me your free book, "Everlasting Health and Strength."

Name.....
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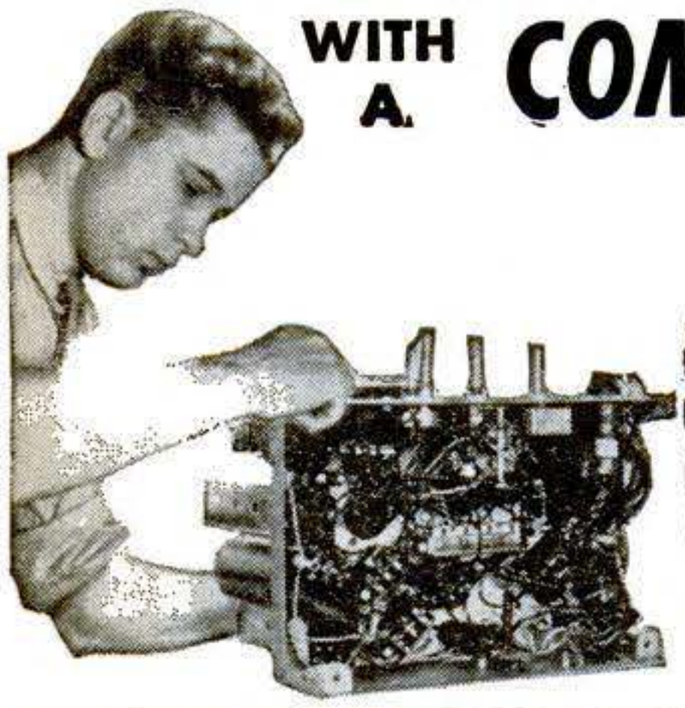

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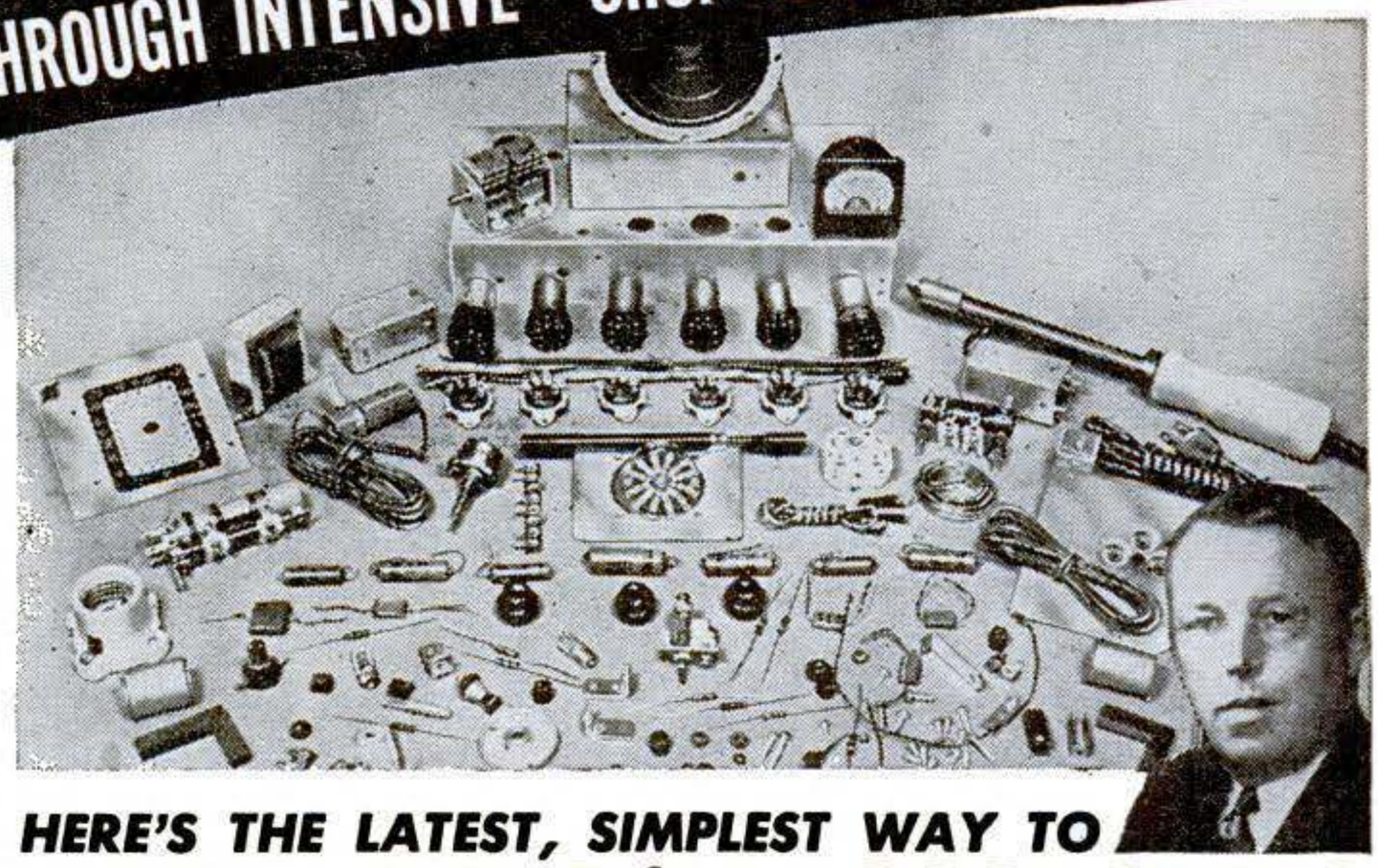

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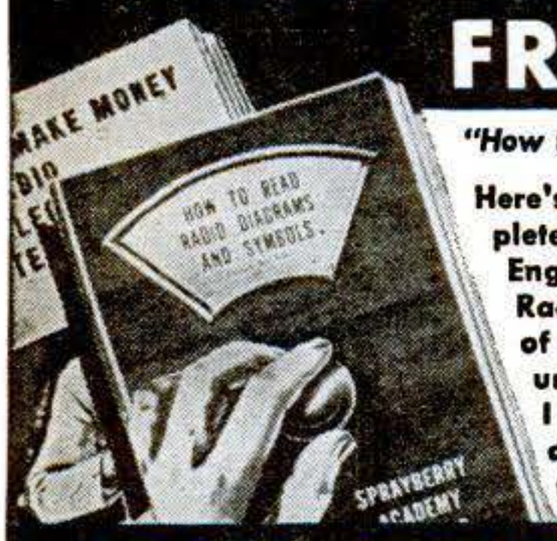

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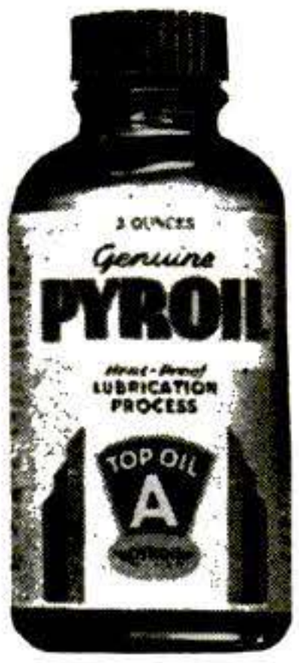

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JATO in Reverse

Sir:

In the progress that aviation has made, it has fallen short in one step: slowing down a plane once it has touched the ground, especially in an emergency. . . . One method I would like to suggest, in which I have failed to observe an experimenting, is utilizing the braking effect of rockets to retard forward motion. . . .

W. G. Dixon

Phoenix, Ariz.

Reader Dixon's suggestion has been echoed by an engineer attending the American Rocket Society convention, so experiments may follow soon.

Dreamboat's Runway

Sir:

Your article on the Dreamboat states that by building a 100-foot section of runway, they linked the Navy's John Rodgers Field and the Army's Hickam Field. A pal of mine who was stationed there contends this is not possible since the two runways are parallel. . . .

Ross E. Roach

Grand Island, Neb.

The runways themselves are parallel, but the fields were joined by connecting the runway of one with a wide taxiway on the other to make a continuous take-off strip.

Dreamboat's Green Light

Sir:

In your December article on the flight of the Pacusan Dreamboat, Col. Irvine mentions seeing a green cast over the rising Arctic sun, which he attributed to the prismatic effect of ice crystals. The "green ray," as this curious coloring is called, can be seen at sunset or sunrise when the sun's rim is just above the horizon. . . . The colors in the sun's spectrum are refracted in the

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following order: violet, blue, green, yellow, orange and red. The rising sun's crescent would be visible first in violet and blue, but the eye is insensitive to these colors. Green, however, affects the eye strongly. . . . Hence we see the sun first in green if the air is transparent enough and the horizon low enough for a pronounced refraction. The crew of the Dreamboat had perfect conditions for observing this rare phenomenon 20,000 feet in the Arctic air.

The weather forecasts for the flight were issued from this AAF Main Weather Central; the problem of preparing forecasts for the 10,000-mile route through the world's worst weather zones would make quite a story in itself.

ALBERT D. ANDERSON

Air Weather Service
Washington, D. C.

PSM feels there is also quite a story in the preparation of "over-the-top" routes for commercial air lines. *See page 76.*

Set Right on Racers

Sir:

Just read your December article on midget racers and wish to point out a common mistake. No. 4 in the illustration on page 134 is not an oil pump; it provides air pressure to force gas from tank to carburetors.

NORBERT M. PHILSON

Philadelphia, Pa.

PSM regretfully admits the error, blushes for its being a "common" one.

Day After Tomorrow?

Sir:

Your November issue illustrates "Tomorrow's Gas Station." It is all very good except that you show a man pumping gas in the same old way—holding the hose and waiting for the tank to fill (and perhaps run over.) It would not seem too much to expect "tomorrow" to have an automatic shut-off on the gas hose nozzle. As a matter of fact, there is a gas station in Darien, Conn., equipped with home-made valves that shut off the flow when a car's tank is full.

HENRY F. ROBBINS

New York, N. Y.

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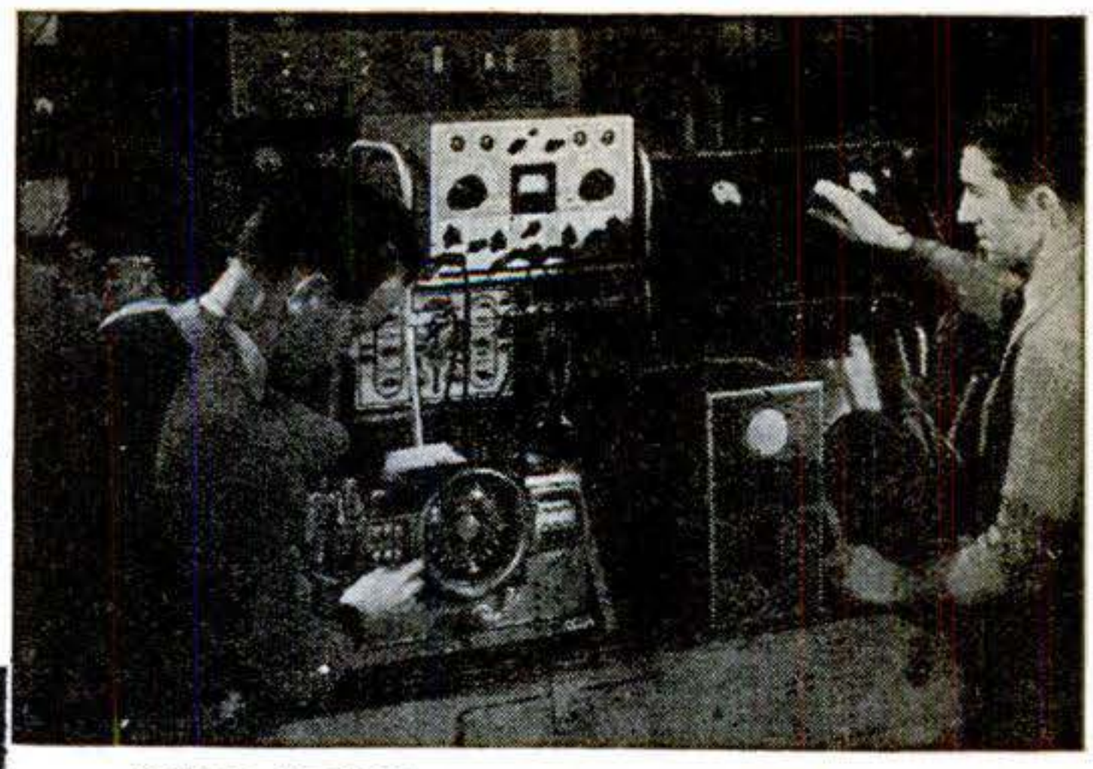
Learn RADIO-ELECTRONICS-TELEVISION



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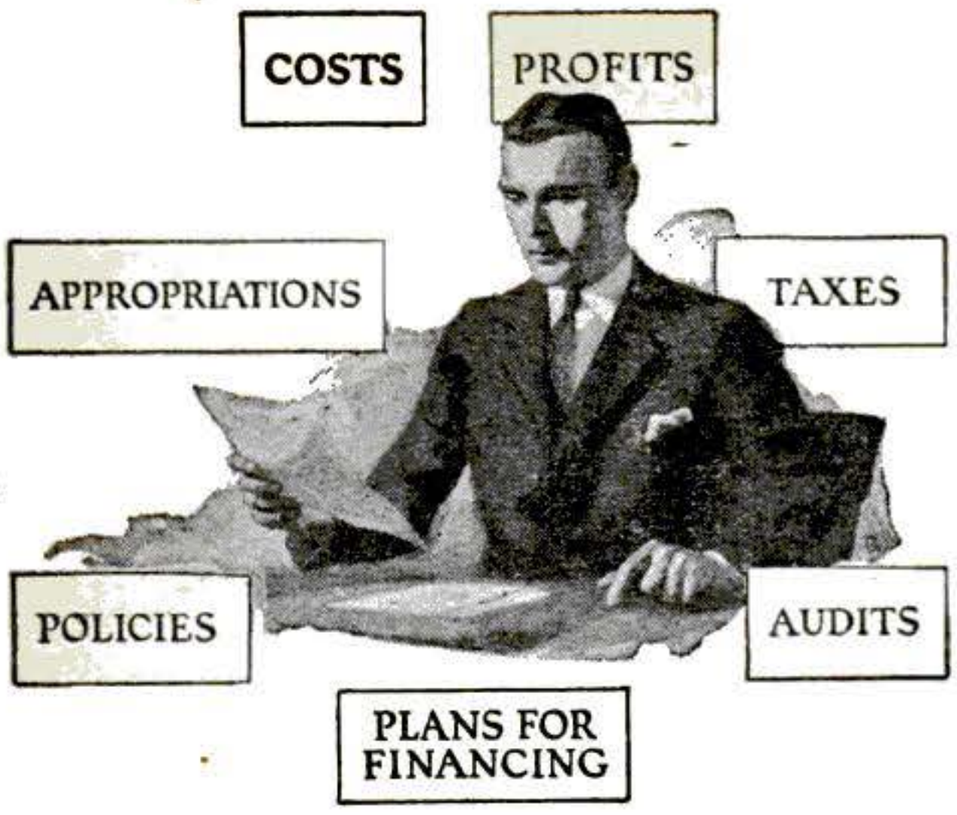

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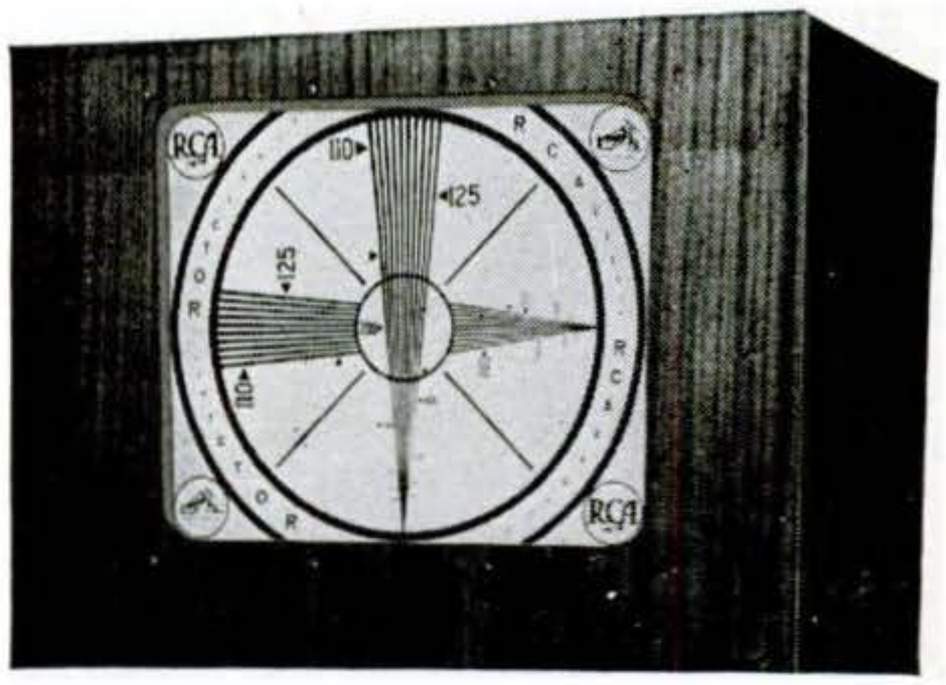

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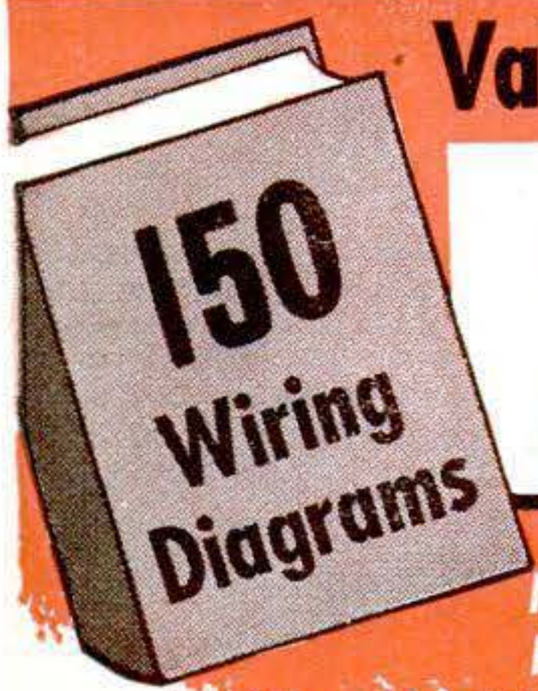

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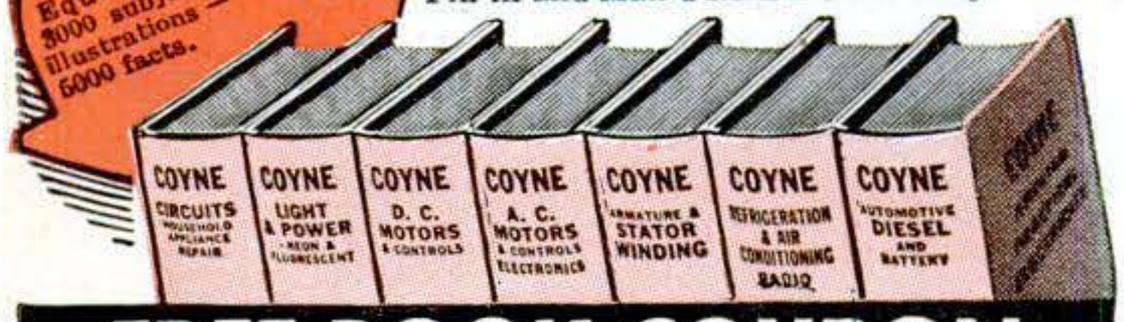

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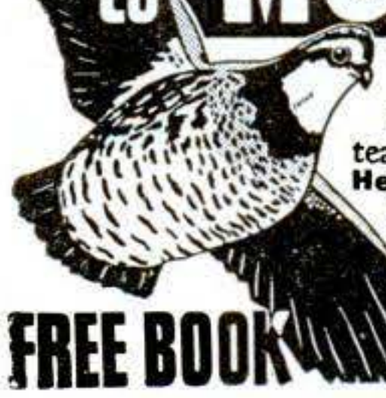

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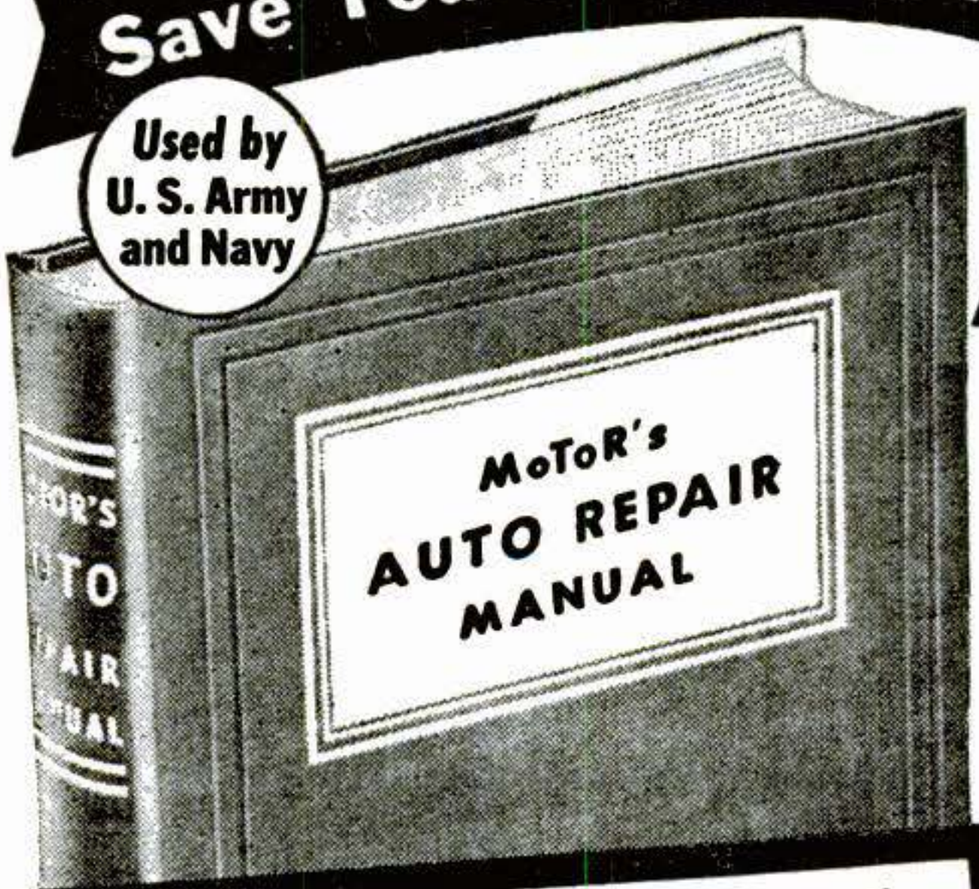

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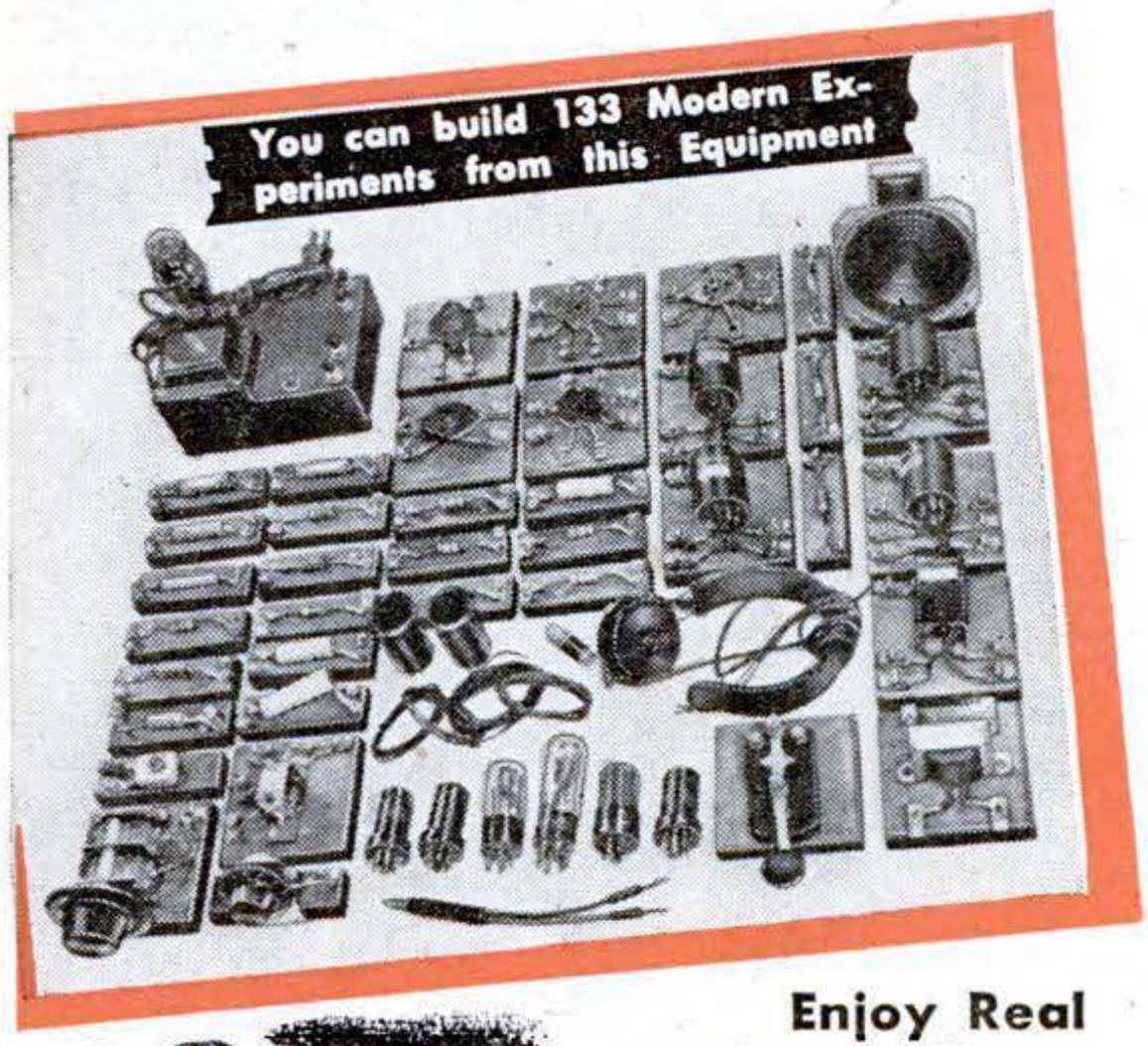

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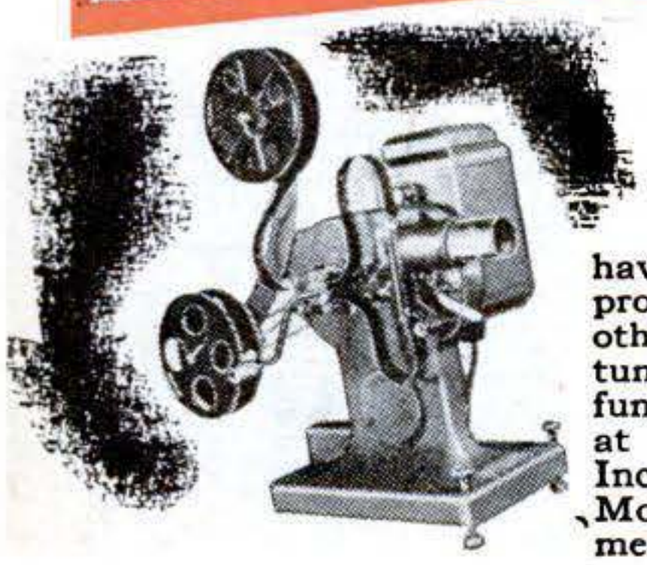

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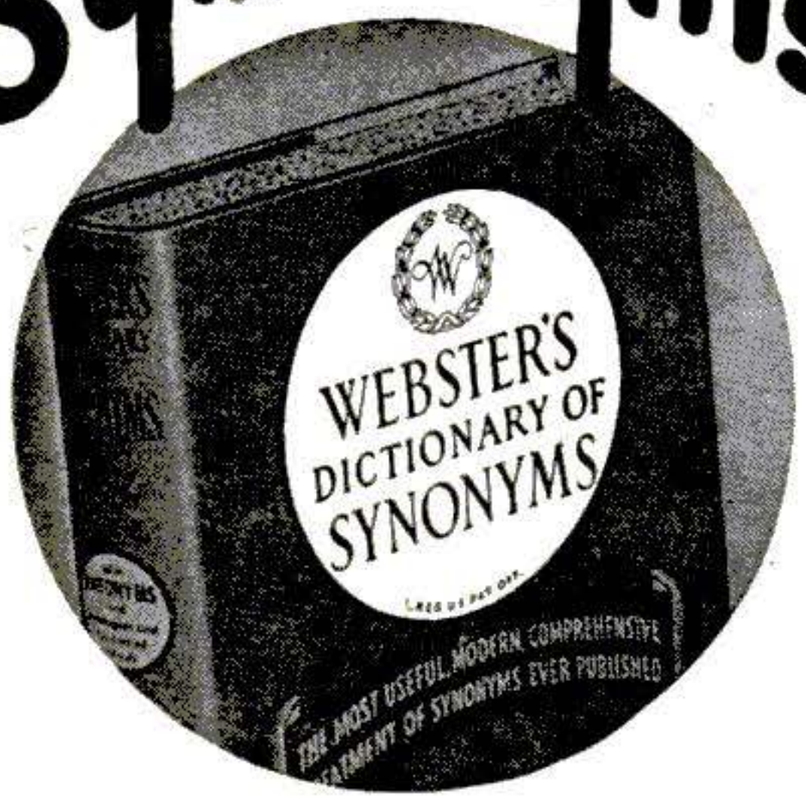

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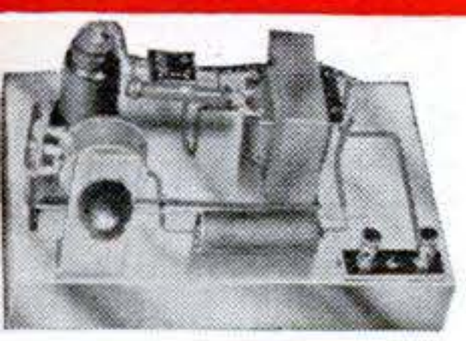

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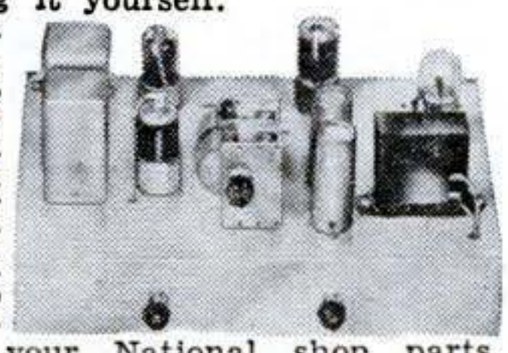

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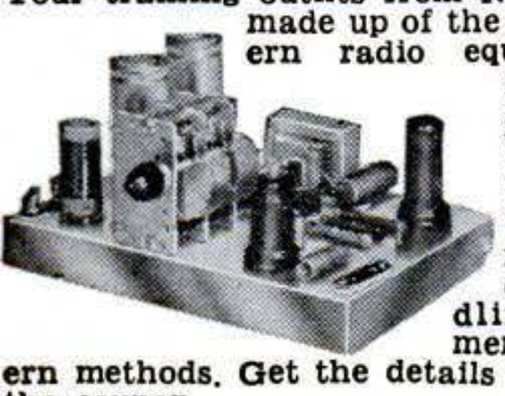

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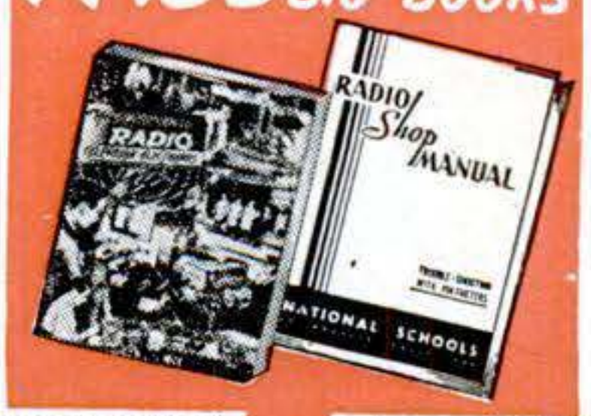

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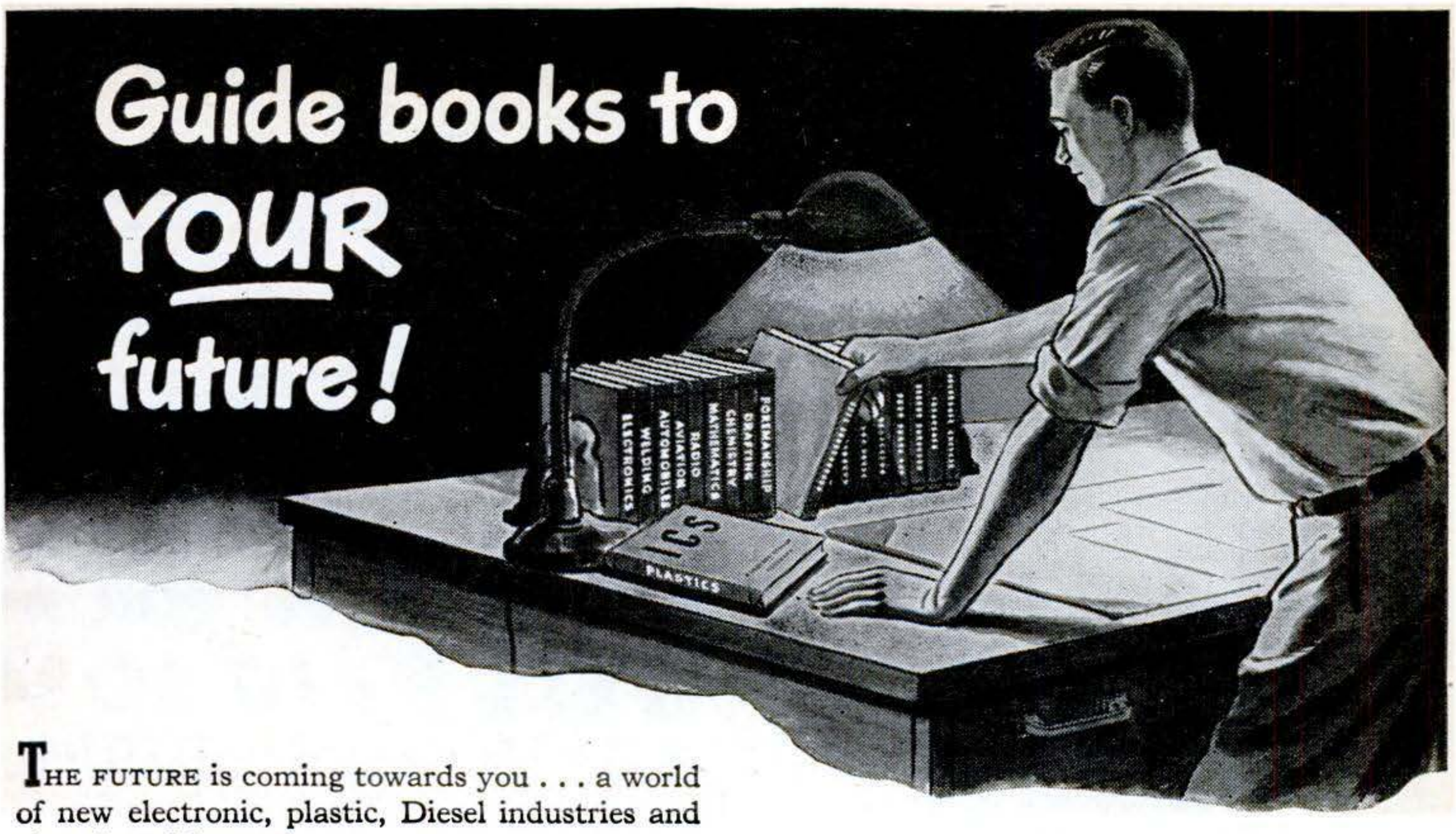

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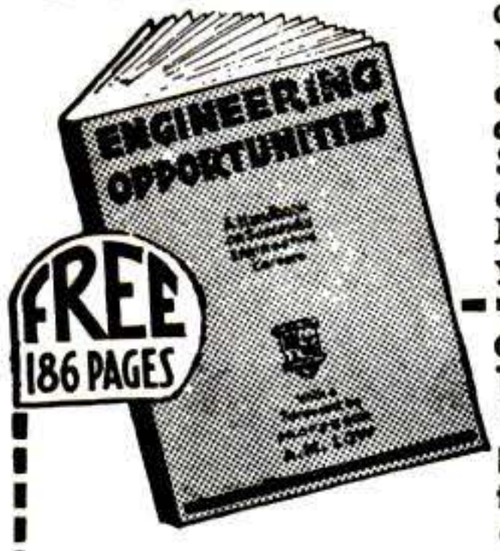

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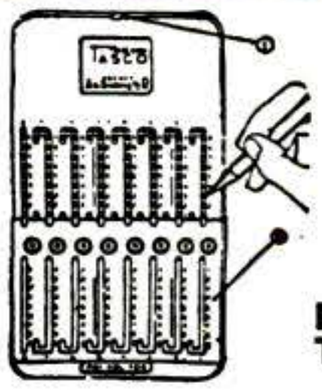

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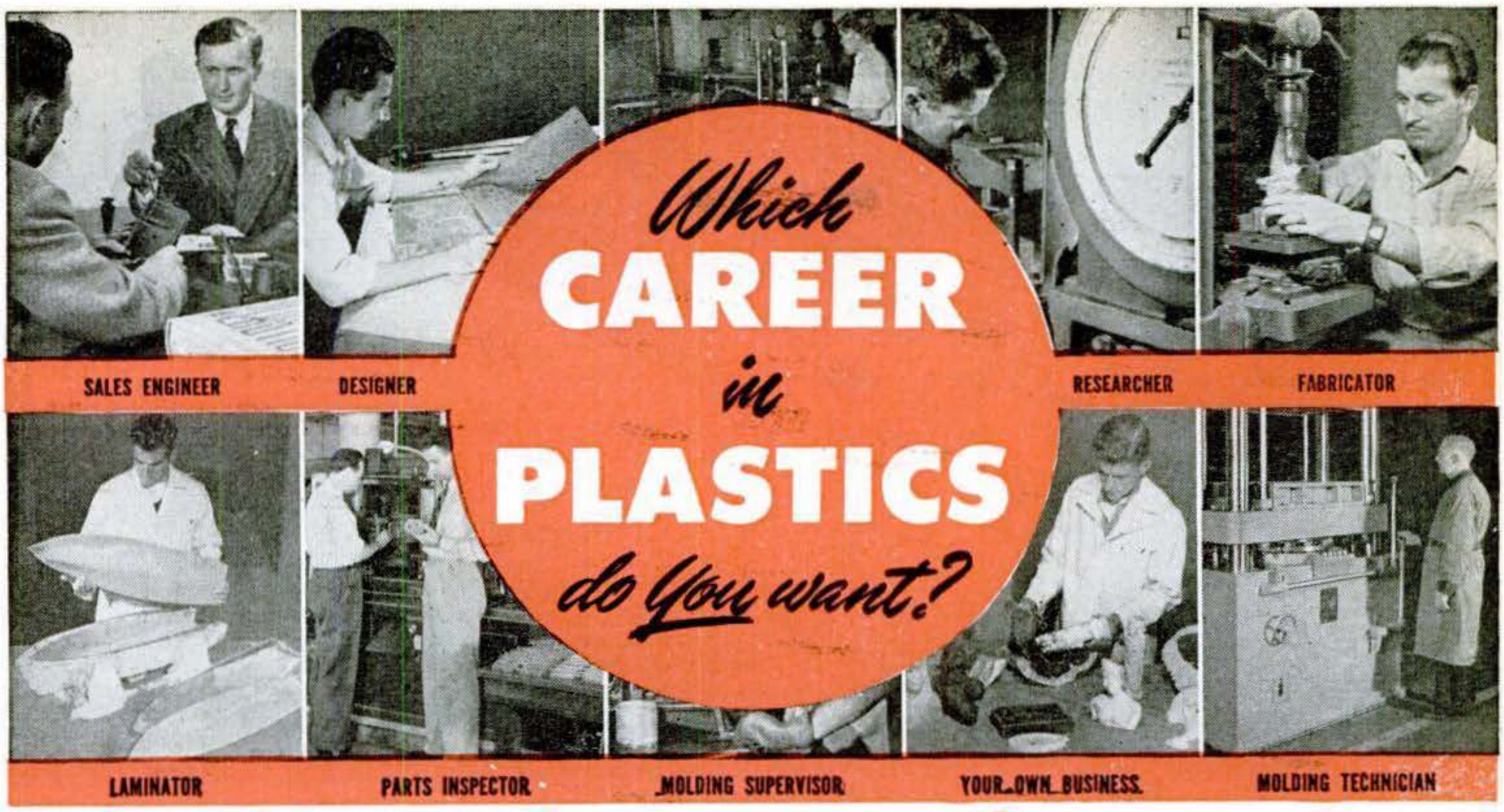

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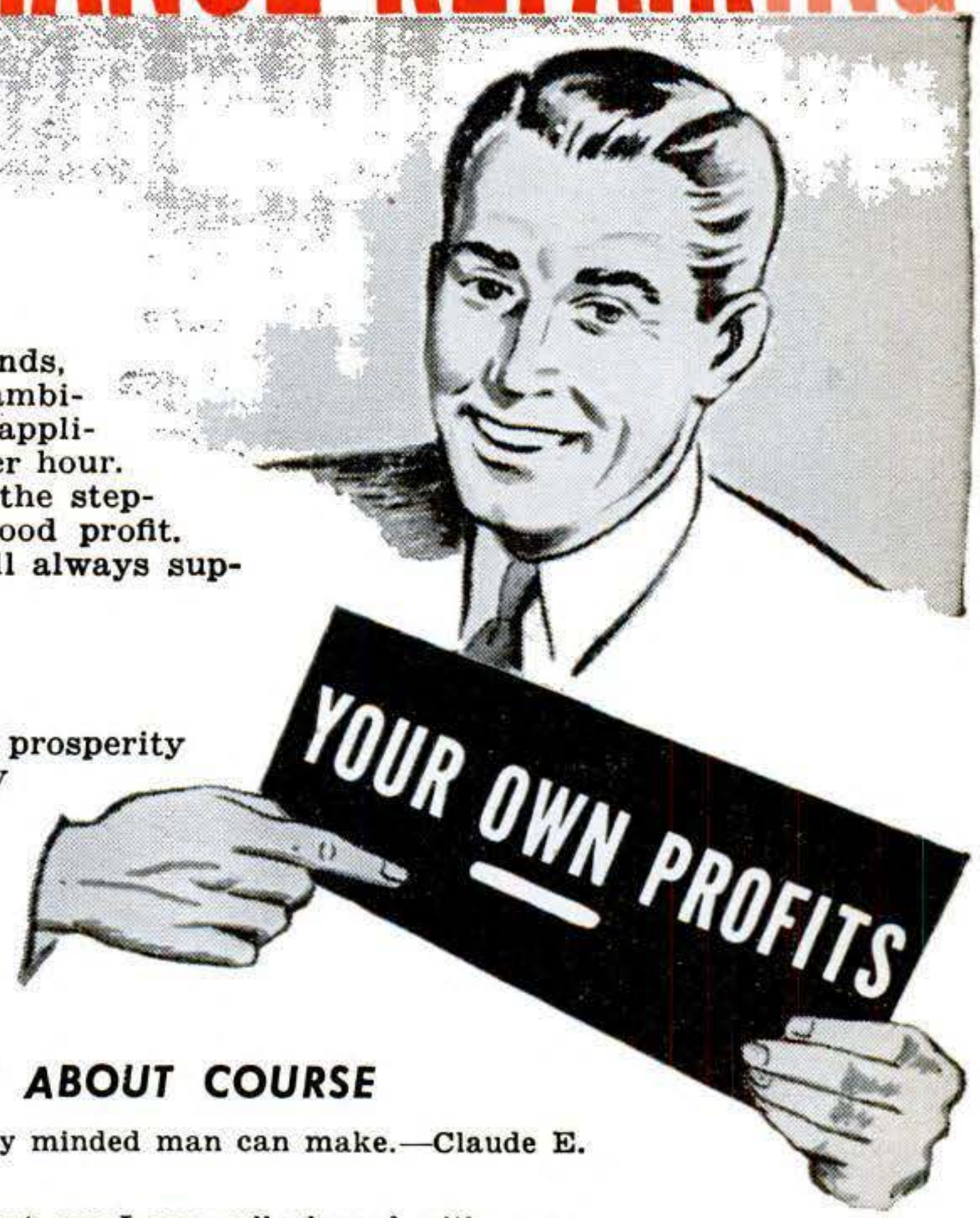

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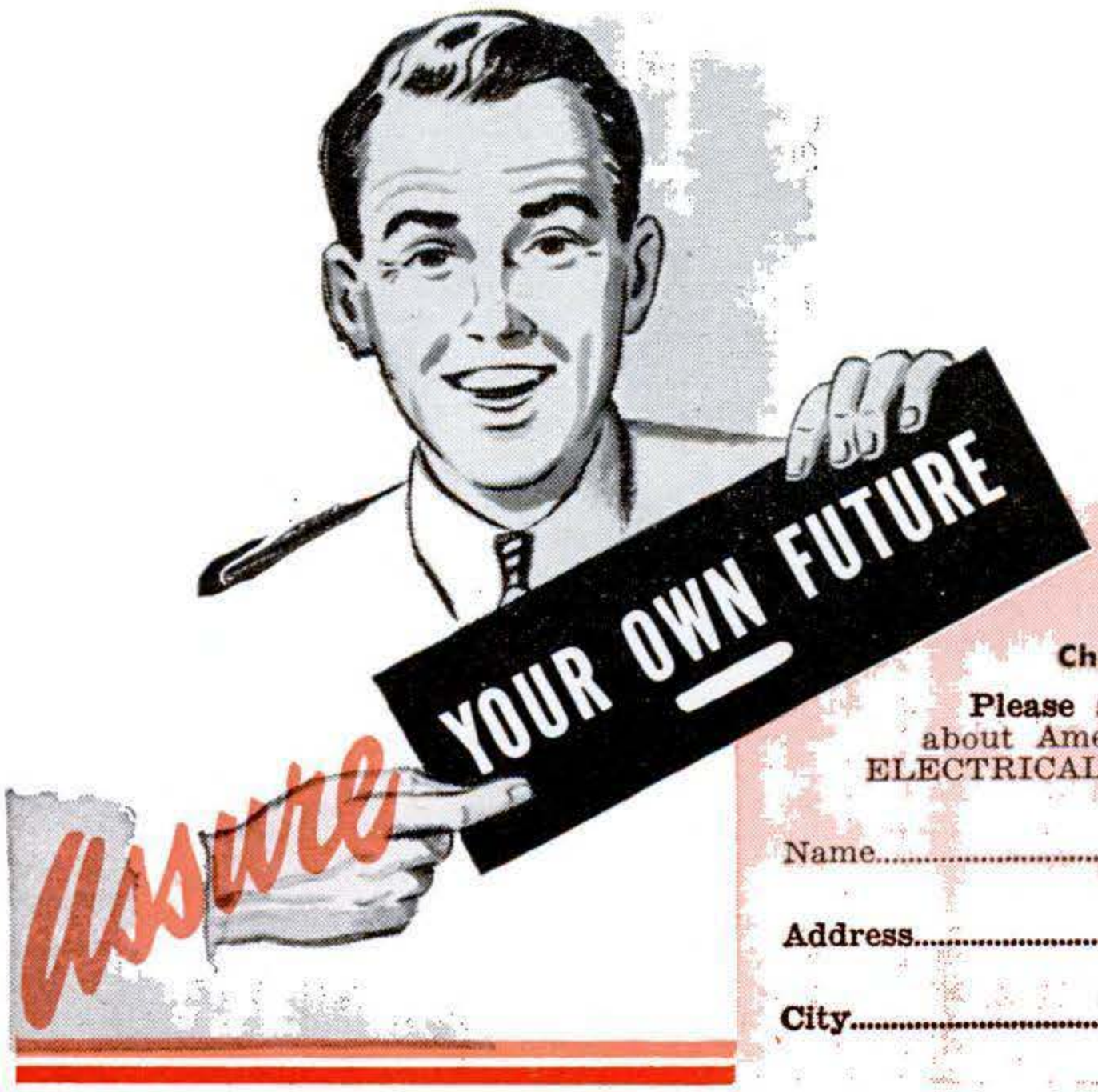

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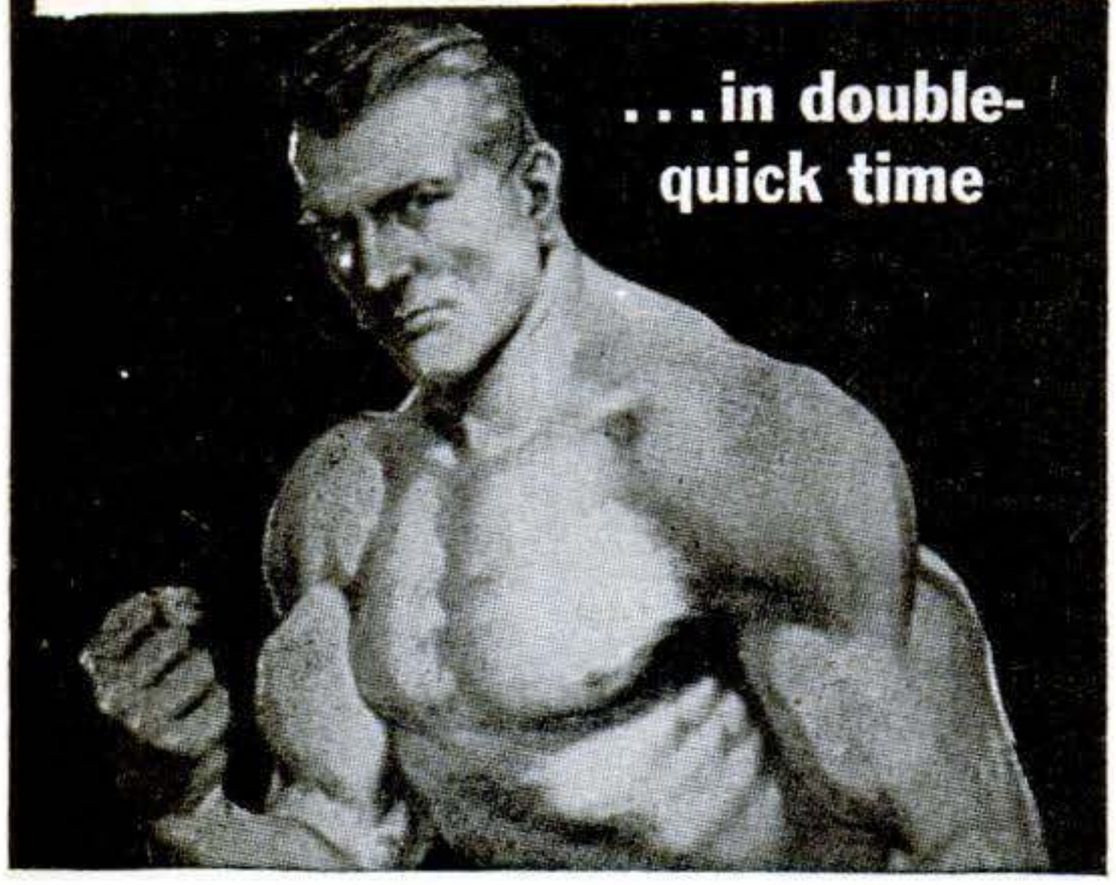

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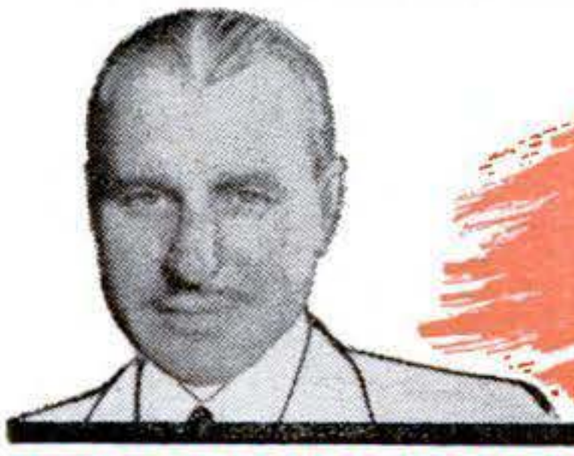

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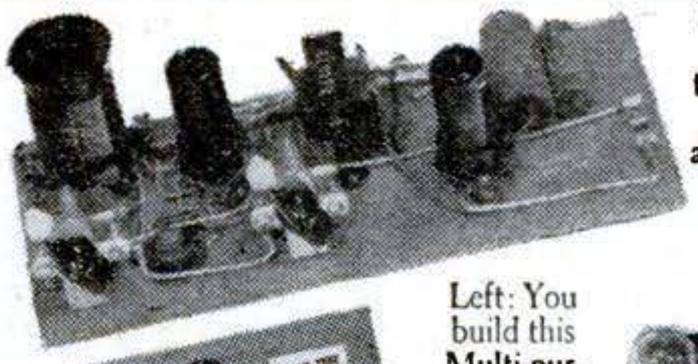
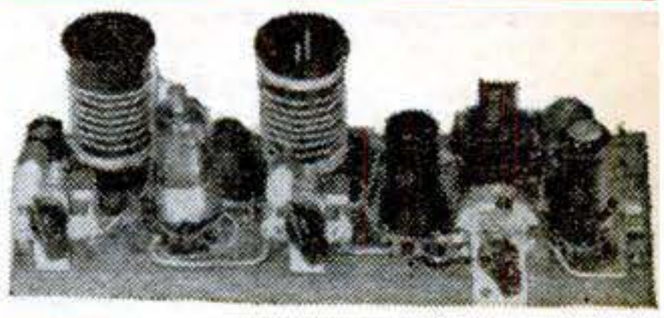
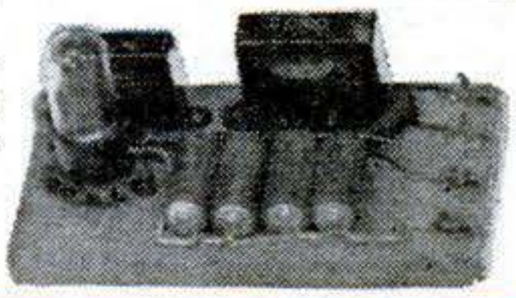


Left: You build this transformer coupled audio stage. (Experiment No. 260)



Left: You build this Multi-purpose Shop Test Panel. 5 Test instruments in one.



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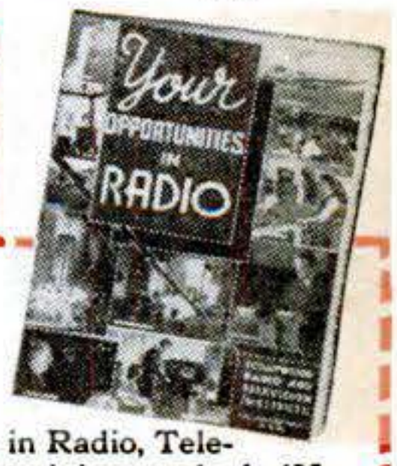

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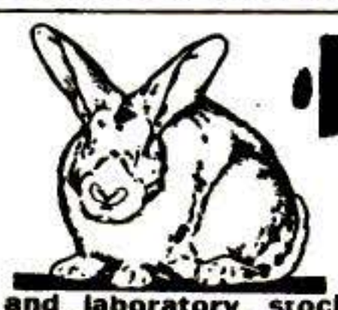

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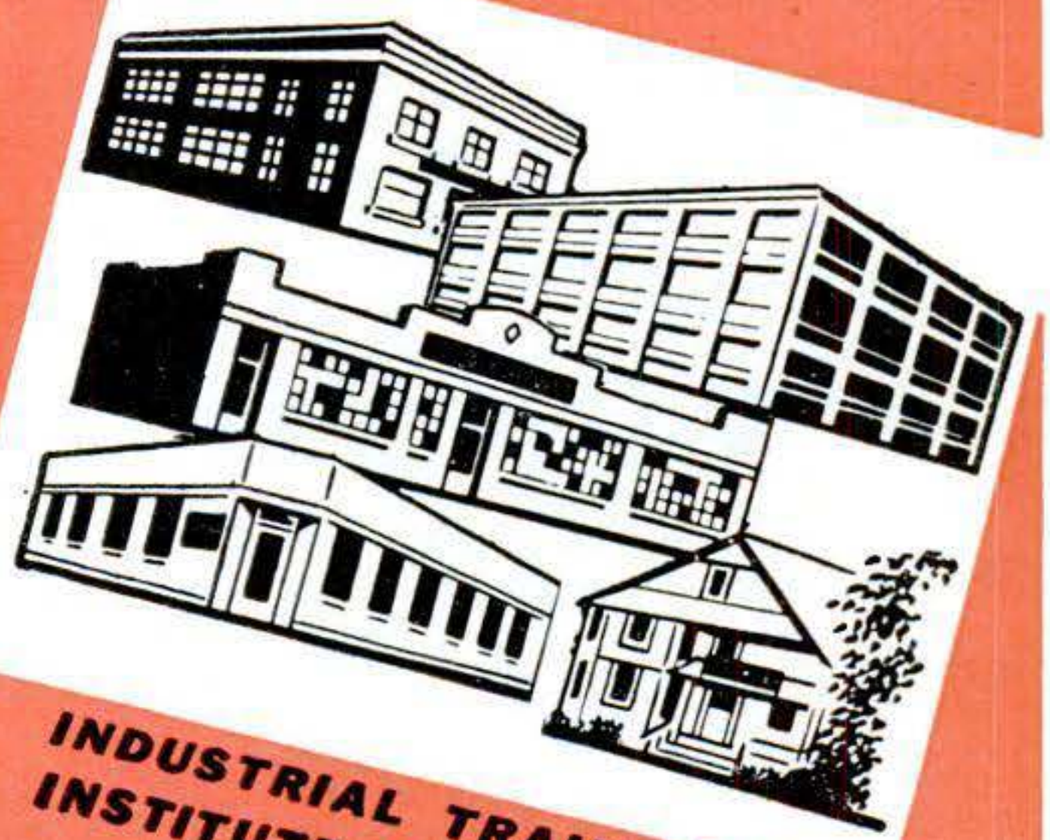

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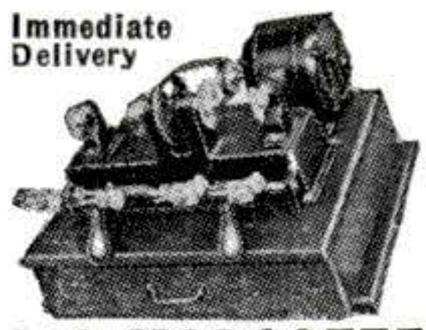

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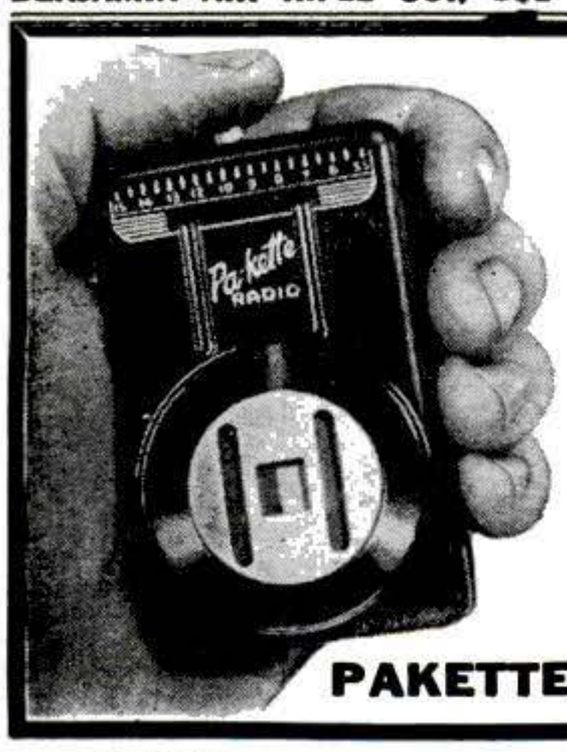

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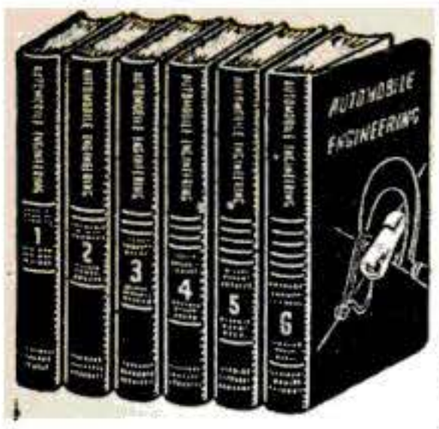

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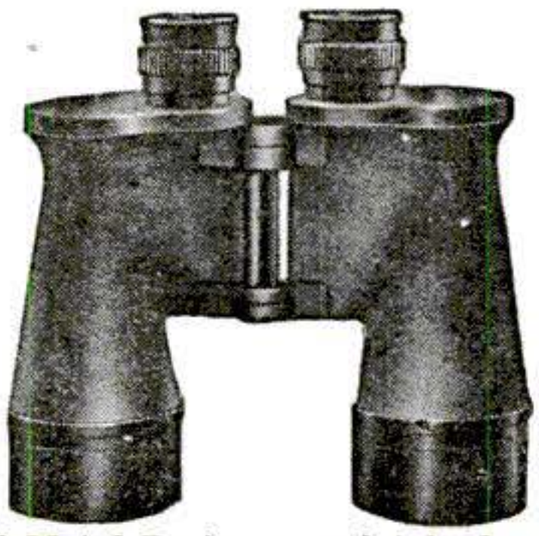

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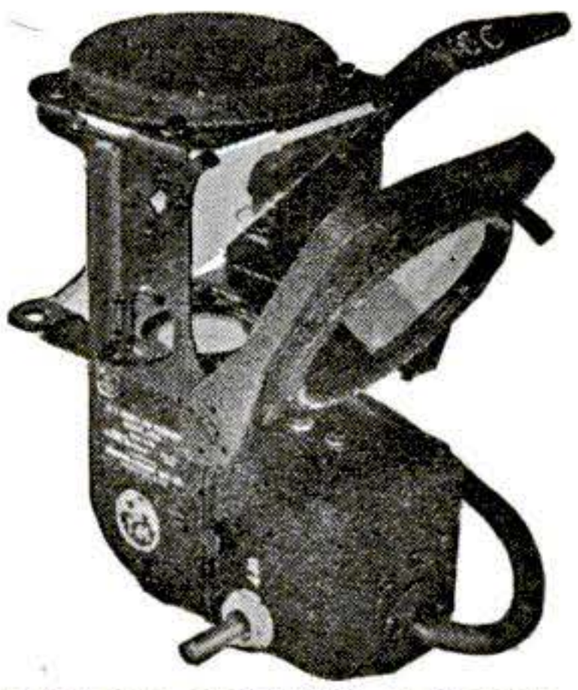

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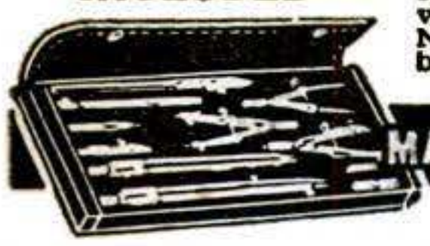

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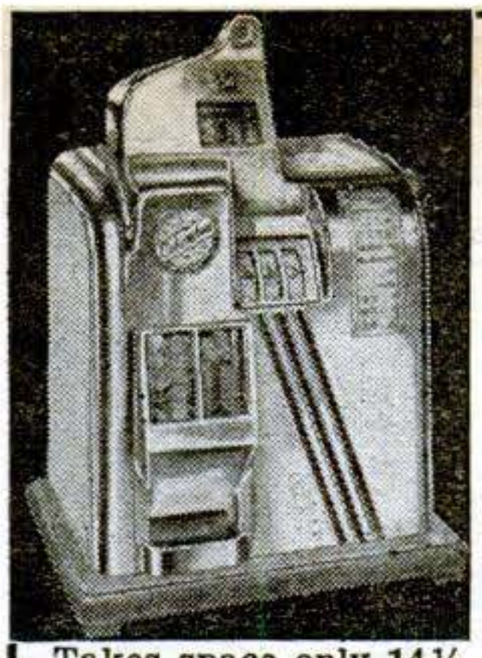

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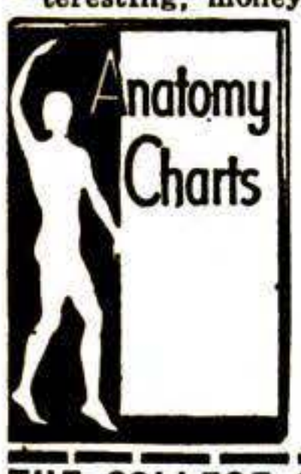

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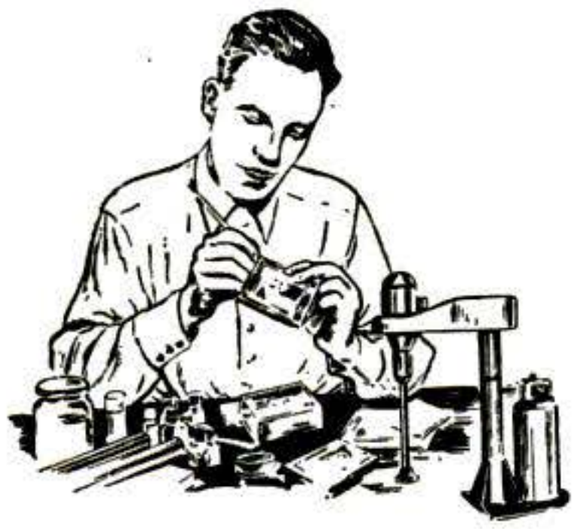

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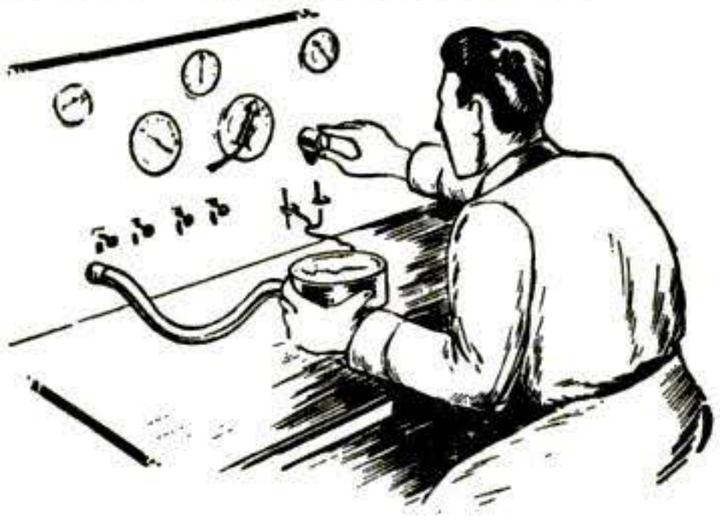

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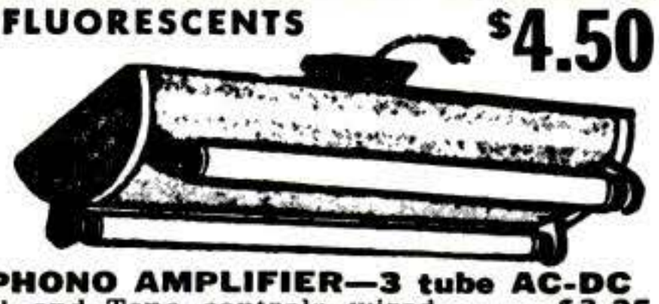

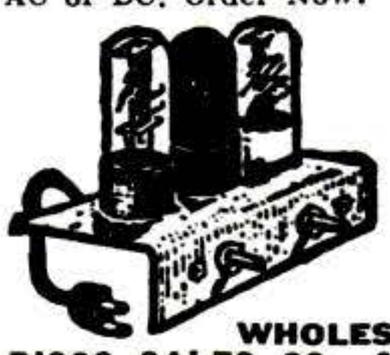

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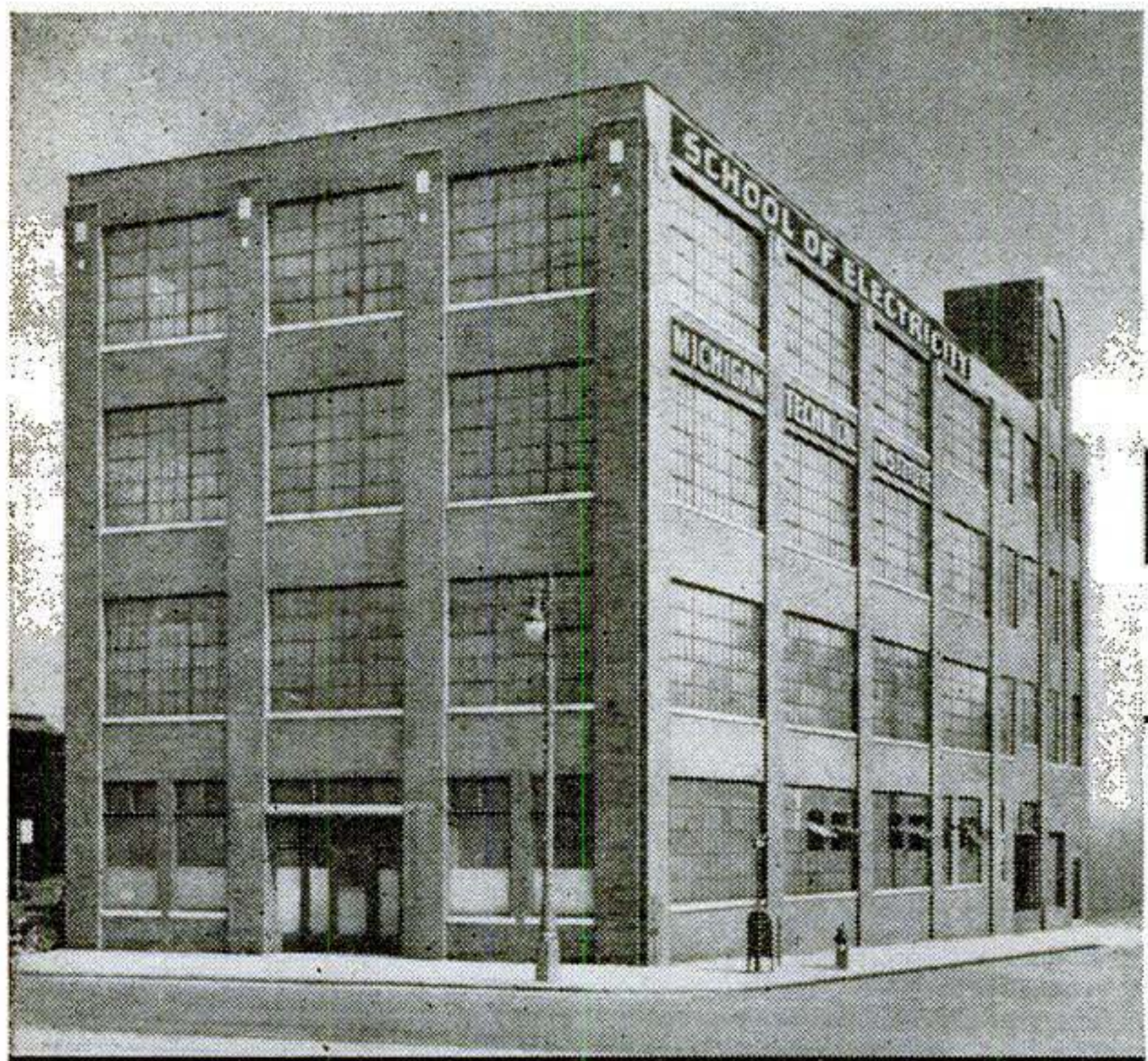

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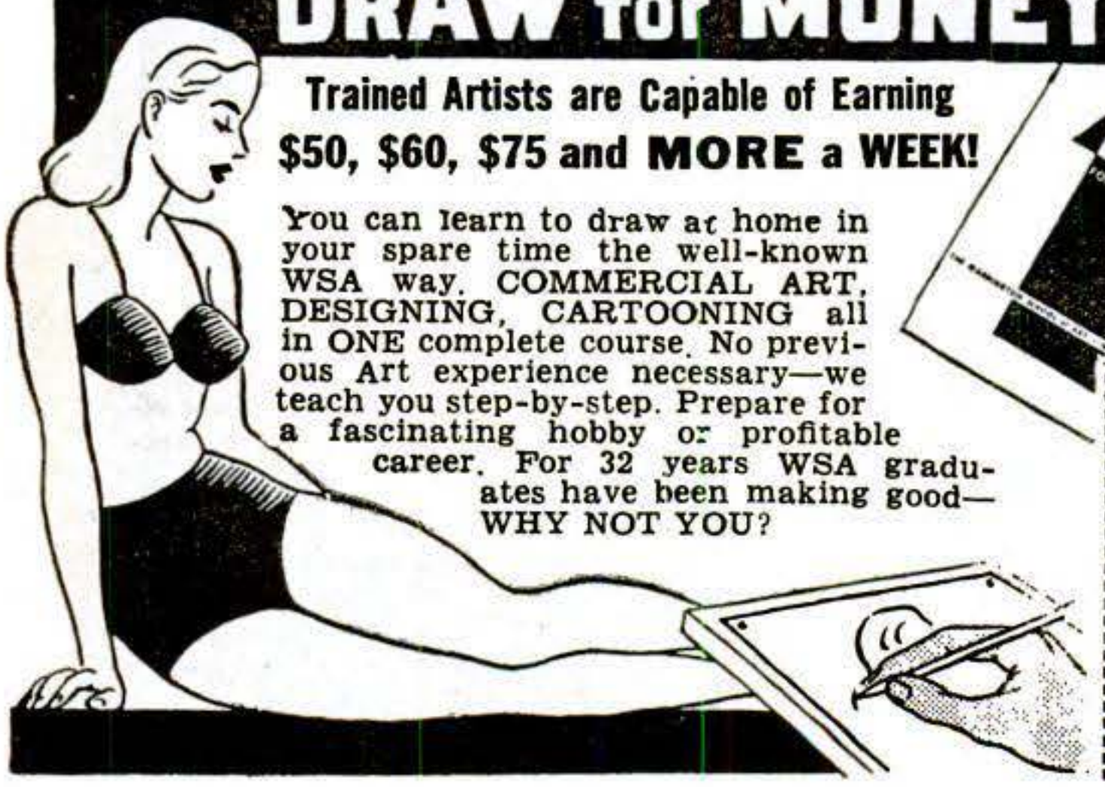

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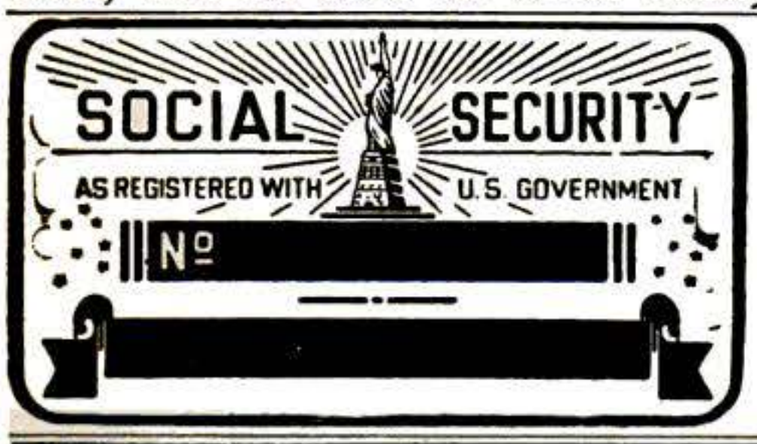

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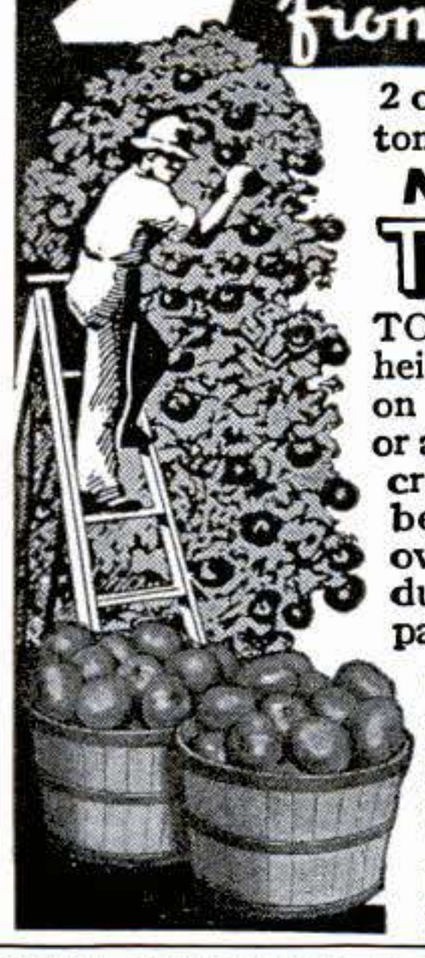

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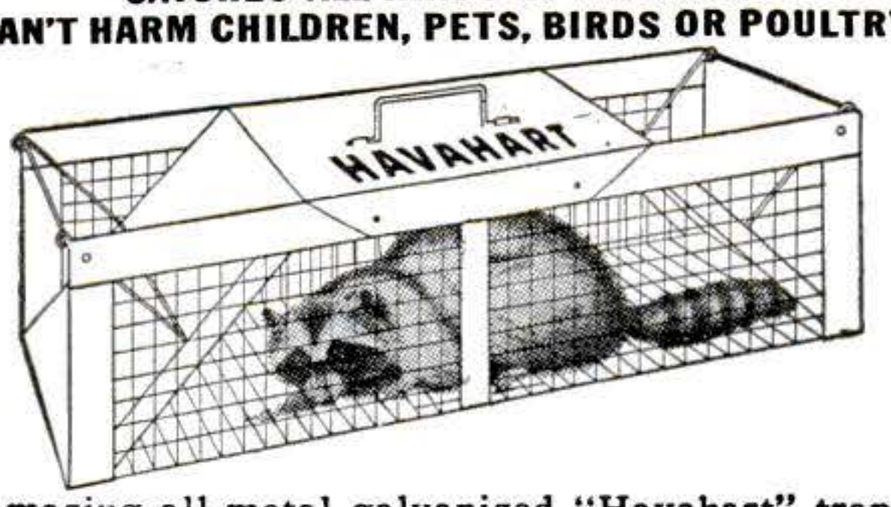

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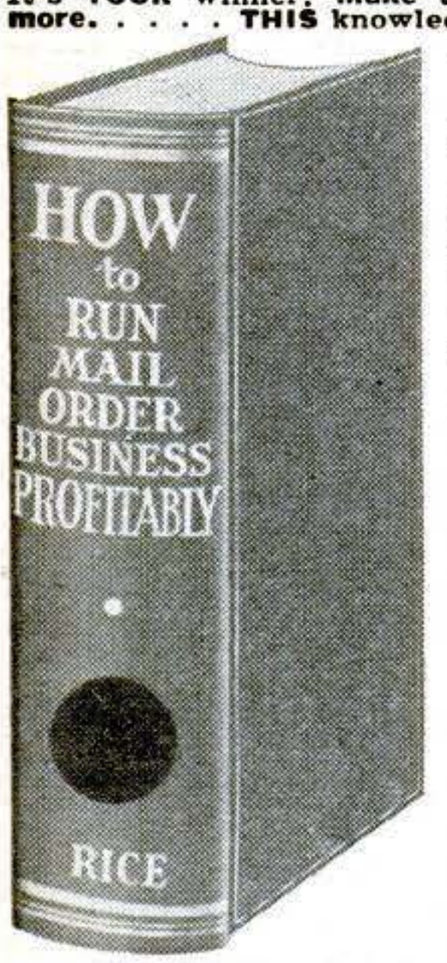

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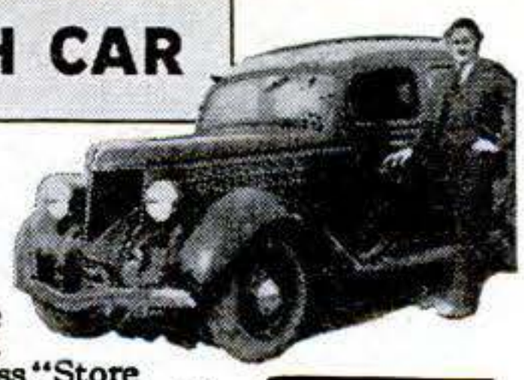

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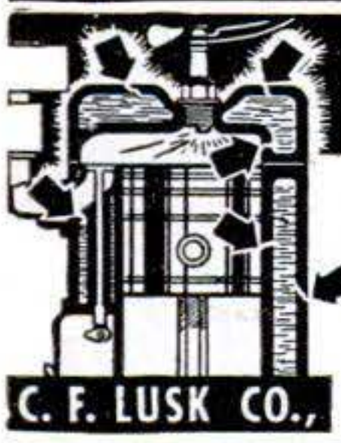

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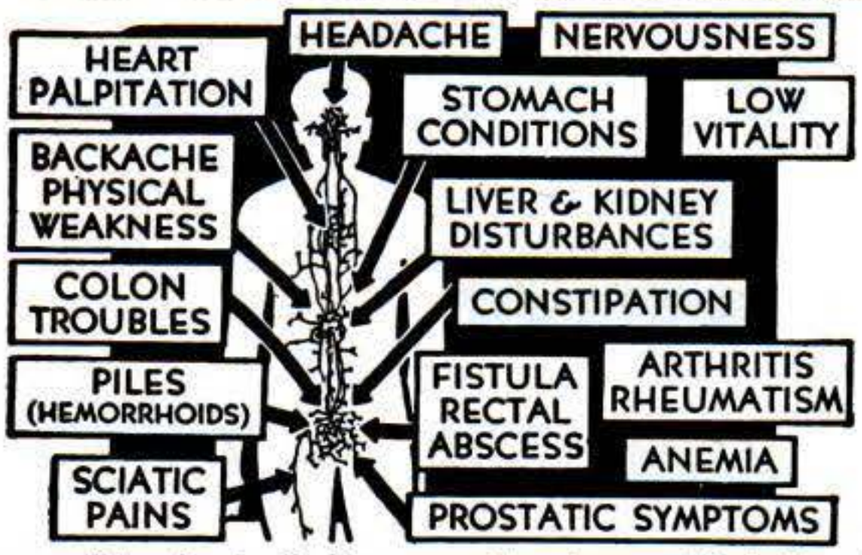

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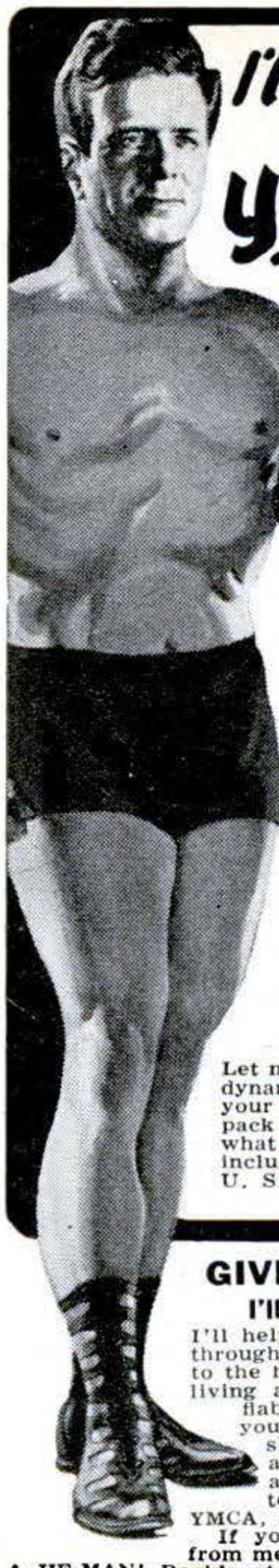

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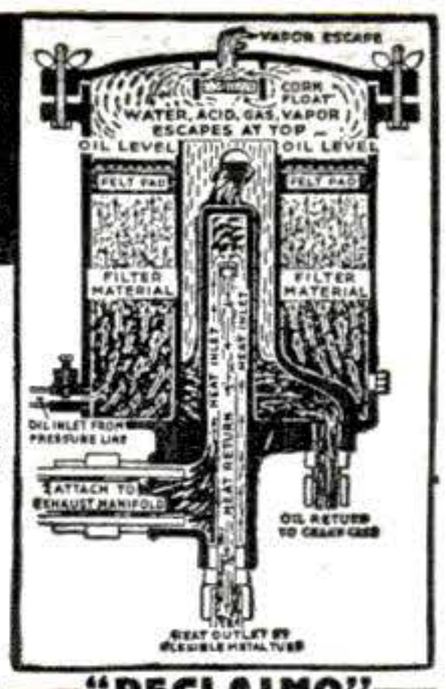

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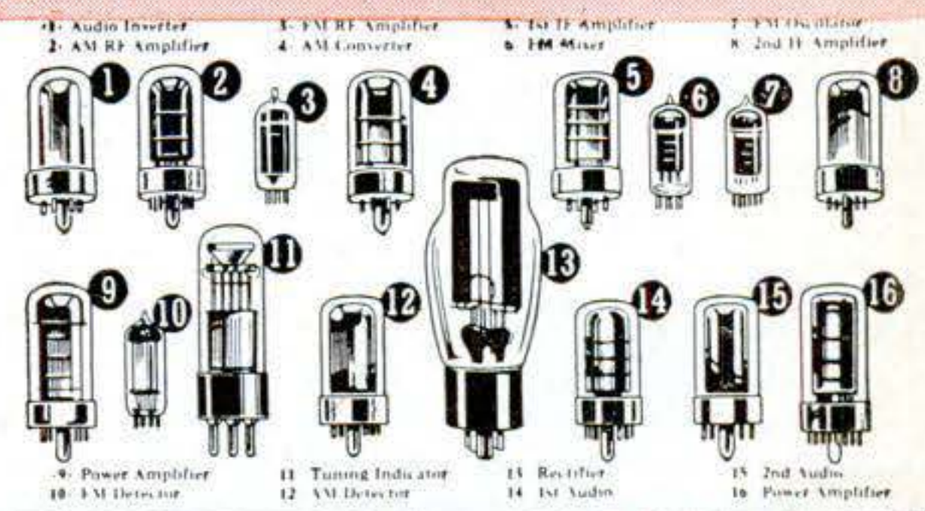

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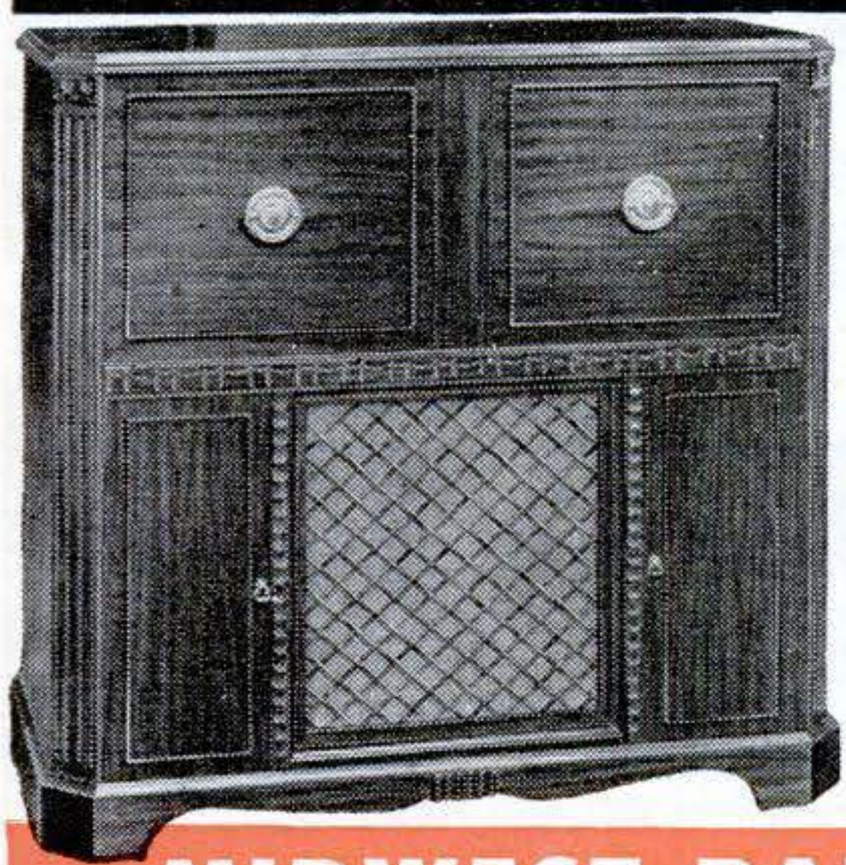

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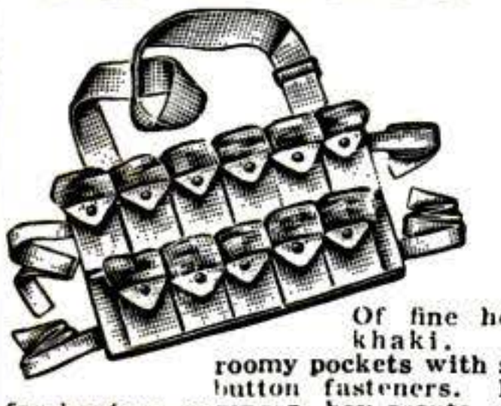

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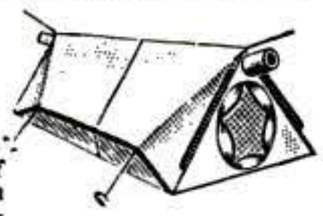
No. 537. Each..... **49c**

2 MAN MOUNTAIN TENT



Regulation Army type two man mountain tent, complete with poles, guy ropes, etc. Of durable nylon with reinforced seams. Ideal for outdoorsmen, campers, etc. Shp. wgt. 10 lbs. A splendid value. **Stock No. 202.** Each..... **$9.95**

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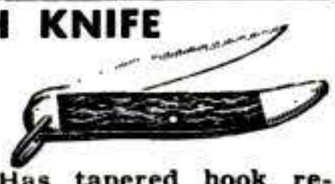


For your fishing tackle box. Bone handle 5" long. 3 in. blade with safety catch. Has tapered hook remover at end. Shp. wgt. 1 lb.

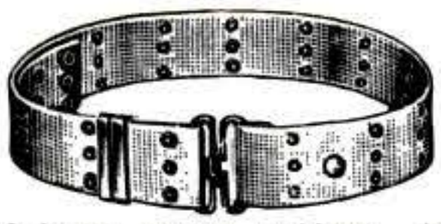
No. 548. Each..... **$1.95**

DECORATIVE CHROME STRIPS

For your car, boat, furniture, etc. Highly polished chrome finished strips with clinched edges for flush mounting to any surface. The 3 pound kit provides approx. 43 pieces in lengths from 4 inches to 3 feet and ¼ to ¾ inches wide. Wgt. 4 lbs.

No. R-224—3 lb. Assort. only **$2.00**

G.I. PISTOL BELTS



Of heavy canvas webbing. Adjustable. Eyeleted all around. Used but perfect. Wgt. 2 lbs.

No. 131. Each..... **98c**

PUP TENTS

Regulation Army Pup Tents of durable, brown canvas. Used, but in good condition. Fine for campers, outdoorsmen, boy scouts, etc. Grand Xmas gift for children. Wgt. 5 lbs.

A-100 Tent only..... **$3.95**

A-110 Tent. New..... **$7.95**

A-101 Ropes, wooden poles and stakes for above. Per set..... **$1.00**

2-Pc. Rain Suits

New 2 piece rain suits. Of durable wear resisting water and wind repellent OD fabric. Bib style pants, zipper fly. Jacket has parka attached. Guaranteed 100% weatherproof. Small, medium and large sizes. Shp. wgt. 3 lbs.

No. R549 Each.... **$4.95**

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All purpose type. Sponge rubber frame. Red shatterproof flexible lens. Adj. head band. With case. New. Wgt. 1 lb.

No. 139. Each..... **39c**

WIRE PLIER

Genuine Bernard 6½ inch wire cutting plier. Parallel opening jaws. Reg. $3.00 value. Wgt. 1 lb. **No. 168.** Each..... **$1.29**

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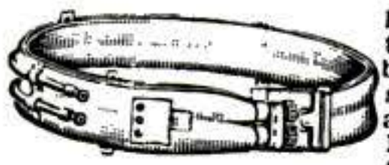
STARK'S

Dept. PS 247
509 So. State St.
CHICAGO 5, ILL

LIFE PRESERVER BELTS



Right from the invasion beaches. Consists of two air chambers. May be inflated automatically with "sparklet" cartridges or manually by attached hose. Adjustable in waist size. One air chamber guaranteed air tight—other may need a tire patch. All belts are used and slightly soiled—but a bargain at this low price.

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FLEET operators: Quick rethreading of "U" bolts. Instructions: $1.00. M. Q. Stade, 332 Davida, Victoria B. C., Canada.

SEE our Ad under Motorcycles for midget racer Bargains. Midget Motors Directory, Athens, Ohio.

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AUTO parts for all autos and trucks. Trans. motors, differentials, fenders, carburetors. Also Body Parts. Security Auto and Truck Parts, 1941 BP Eddy, Chicago 13.

MAKE your Ford fast! Complete details, photographs. How to construct 120 mph Hotrod. $1 postpaid. California Bill, Eaglerock Box L-2, Los Angeles 41, Calif.

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GRILLES for most all cars. Meyers Auto Parts, 820 Dryades, New Orleans, La.

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LARGE stock Indian parts. Expert motor rebuilding. New and rebuilt Chief Motorcycle, motors only. Indian Motorcycle Sales, Kansas City 1, Mo.

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CUSHMAN motorscooter $25 complete; midget car $28; midget car less motor $10; Midget motorcycle $25, German Sachs Motorcycle $50, less motors; motors $3 up. Over 5400 small balloon tires $1.50 up, mailorder only. Send 25c for big War Bargain catalogue, Number 17, listing the above and hundreds of other bargains in new and used motors, motorscooters, midget cars, motorcycles, outboards, etc. (35c by first class mail) Midget Motors Directory, Athens, Ohio.

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ARMY Surplus! A-9 cloth helmet, 99c. B-6 leather sherling helmet, $2.49. Knit OD Watch cap, 79c. Tan K-1 zippered flying suit, $8.95. (medium-small only). Army Leather brief cases, $7.95. Aero Parts, Municipal Airport, Houston, Texas.

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JET Propulsion Experiments. New Principle, drive boats, bicycles, model helicopters. Circular on plans. Rush name. Maupin, Tipp City 7, Ohio.

PROPELLERS—Illustrated literature, correct type, sizes for ice-snow sleds, boats, Airliner 3 blade, also 2 blade. Build your own motor, aircool diagrams 50c. Standard Aerocraft, Ft. Worth, Texas.

BUILD and fly your own motorcycle powered monoplane at home. Easy to build short run takeoffs, sweet plane to fly. Tested plans include complete detailed blueprints and all necessary information about materials, dimensions, and method of construction for only $3.00. No special tools needed. Order today, Now. Aerotech, Dept. 1, Dearborn, Michigan.

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FLUORESCENT tubes burned out? You can relight and use indefinitely. Complete Instructions $1.00. Wallingford, 121 Burlington Ave., York, Nebr.

FREE Catalog of welders, welding supplies, generators, fencers, and other electrical items. Write LeJay Company, Minneapolis 8, Minn.

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WE repair any make toaster, clock, waffle, Irons, percolator, mixers, malt mixers, reasonable. Pierce, 201 W. Washington, McAlester, Okla.

NEON Business Signs. General Sales Service, Box 1092, Roswell, New Mexico.

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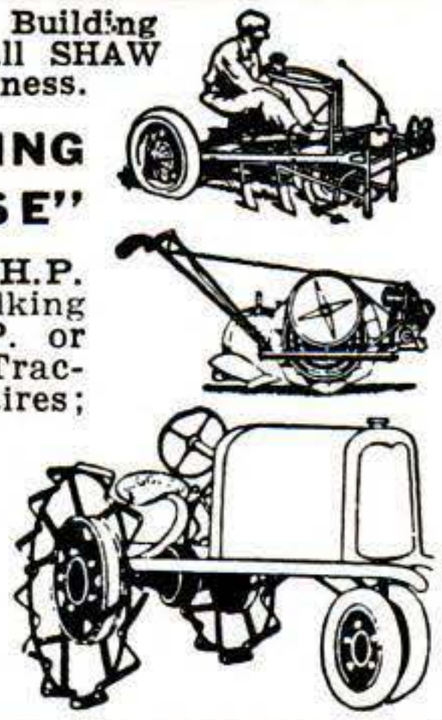

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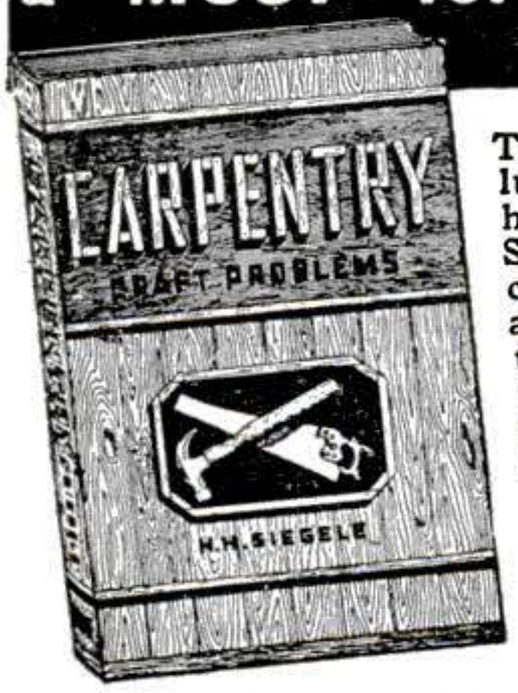

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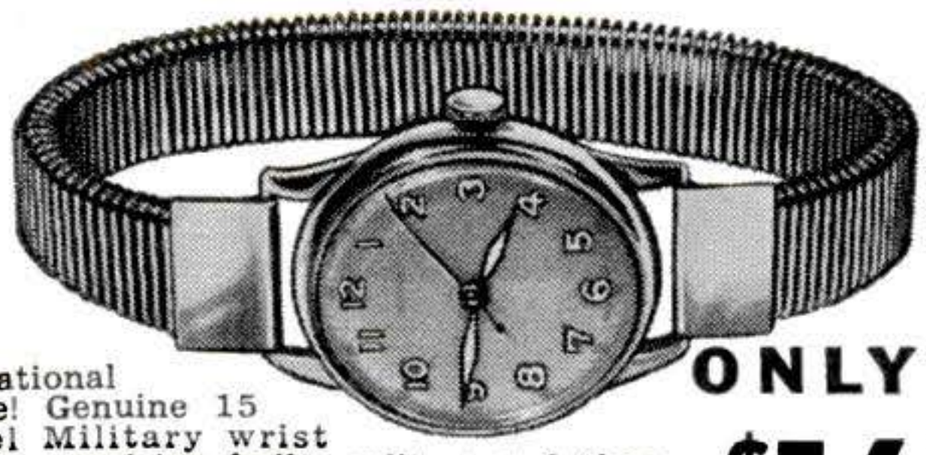

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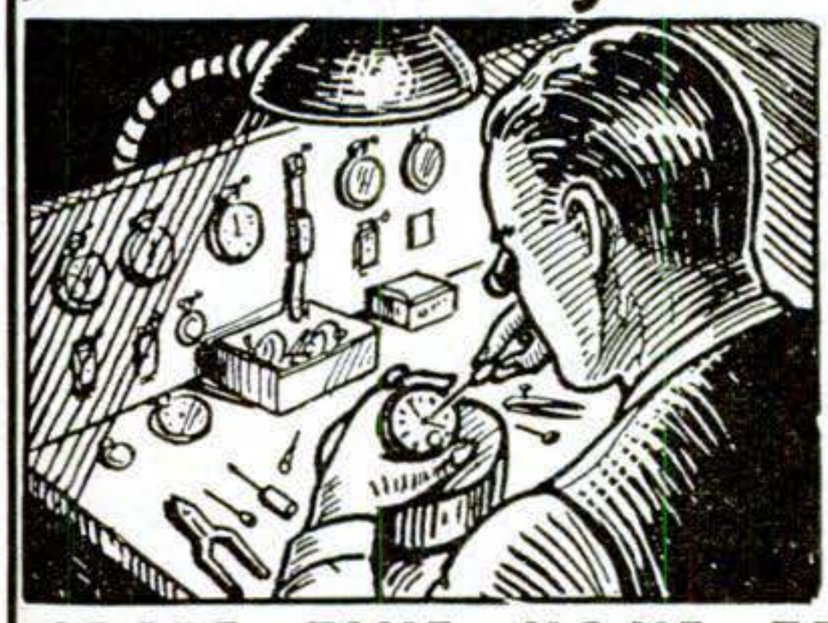

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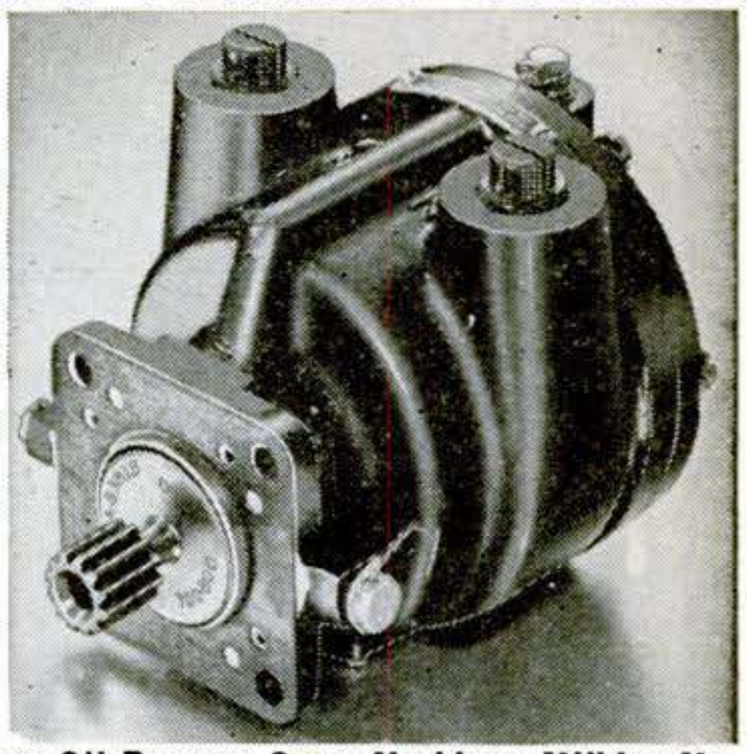

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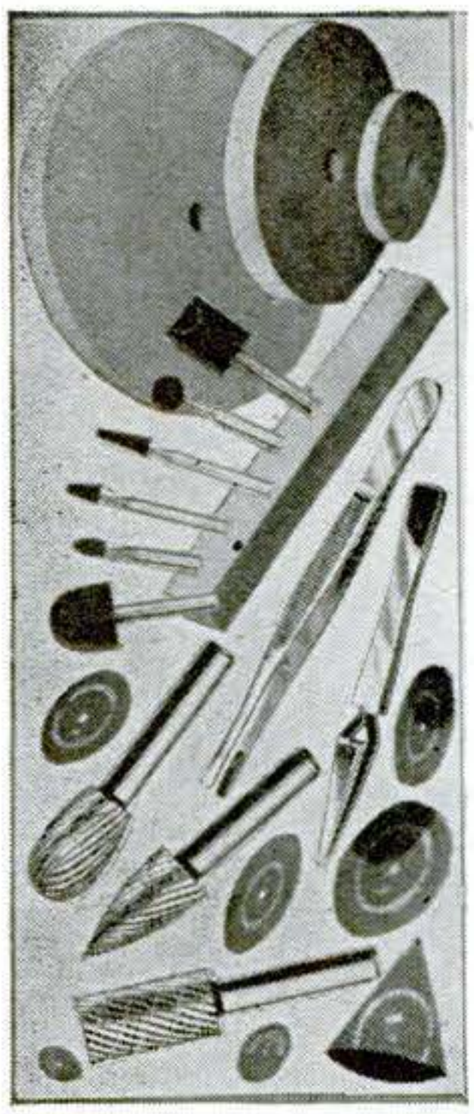

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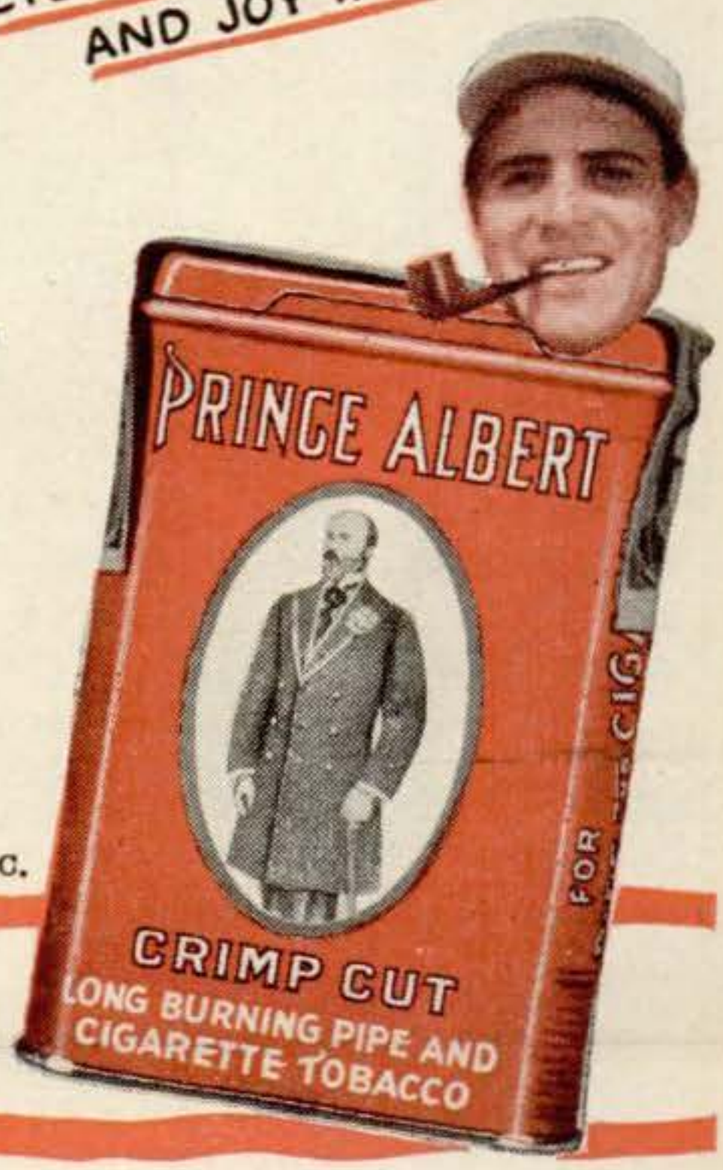

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